# OPERATING INSTRUCTIONS

# MODEL TTS 4

## Series of
## TRANSMISSION TEST SETS

324 6511

## Models
## 4AN - 4ANH - 4ANHR - 4ANHRV


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# MODELS TTS 4AN/4ANH TRANSMISSION TEST SETS

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# MODELS TTS 4AN/TTS 4ANH TRANSMISSION TEST SETS

## OPERATING INSTRUCTIONS

## 1.0 GENERAL INFORMATION

**1.01** The Model TTS 4AN Series of Transmission Test Sets was designed to operate in the audio frequency range and to permit transmission measurements over a wide variety of telephone circuits. The set contains low resistance holding coils and can therefore be used on circuits which carry DC, such as local exchange or PBX circuits, as well as on 2-wire or 4-wire toll and program circuits. In addition to the self-powered, transistorized transmission measuring circuits and their associated switching provisions, the set contains a 600 ohm +2μf and a 900 ohm +2μf precision termination and a talk circuit. The talk circuit contains associated circuitry such as a hook switch control, a neon bulb to indicate incoming ringing in the ON HOOK condition, and a talk battery. A 4 1/2" mirror scale meter, which includes red and green arcs for VU measurements, is centrally located on the panel.

**1.02** A connector is provided for connecting external frequency determining networks; these are located in accessory slip-on covers and provide both switchable and continuously variable frequencies. Jacks are provided to accept a 52A or equivalent headset and a dial. When equipped with the external dial and a 52A headset, the set duplicates the functions of a subscriber dial set.

**1.03** All connections to the test set are made through standard telephone type jacks arranged along the lower edge of the front panel. The sleeve circuits of the jacks are connected to pin jacks to provide for external connections. The TTS 4AN series of equipment provides a SEND 309-310, LINE 309-310, REC 310, REC DIR 310, and an NMS 310 jack. The REC DIR jack gives direct access to the amplifier-meter circuits, thereby eliminating the frequency response of the receive transformer. The NMS jack makes it possible to connect DC devices which do not provide a path for DC current, such as certain types of noise measuring equipment, to the line while holding the external circuits through the DC path provided by the hold coil in the TTS 4AN set. The LINE 310 jack and the REC 310 jack are located adjacent to each other and they are spaced to permit insertion of a twin plug. This arrangement facilitates testing of 4-wire systems; for these systems the LINE 310 jack provides the send functions and the REC jack provides the receive functions. Whenever a twin plug is inserted in both jacks, the REC jack prepares a 600 ohm +2 mfd terminating circuit or a 900 ohm +2 mfd terminating circuit (depending on the position of the REC IMP switch) through extra springs on that jack. This termination is extended to the line circuit through disconnect springs on the NMS jack whenever the LINE switch is in the REC position; thus it terminates the send leg of the 4-wire circuit. The same circuit is established when a single plug is inserted in the REC jack.

**1.04** To facilitate measurements on 4-wire circuits, and to provide test terminations, special terminating resistors have been added. Their purpose is as follows: assume that a 4-wire circuit is terminated at the distant end by a 4-wire termination set and that a test signal is applied to the 2-wire side of this termination set. Assume also that it is desired to measure the transmission loss from the 2-wire far end circuit to the receive leg of the near end 4-wire circuit. In this case it is necessary to make sure that no signals are applied to the near end send leg of the 4-wire circuit. If signals should, by mistake, be applied to the near end send leg, part of their energy will be transmitted through the far end hybrid and be added to the far end test signal; the only occasion when this does not occur is when a perfect hybrid balance exists at the far end. This extra signal will result in erroneous transmission loss measurements. To insure that no signals can be applied by the TTS 4AN set to the near end send leg, the line circuit of the TTS 4AN is terminated in either 600 ohms +2 mfd or 900 ohms +2 mfd whenever the LINE switch is in the REC position while, simultaneously, the receive leg of the TTS 4AN circuit is patched into the REC jack of the set. The position of the REC IMP switch determines whether a 600 ohm or 900 ohm termination is used. As precision, non-inductive resistors are used, this circuit can also provide a test termination on the LINE jacks for other measurements. Note, however, that a plug, preferably a dummy plug, must be inserted into the REC jack to complete the circuits which connect this test termination to the LINE jacks.

**1.05** The TTS 4AN and TTS 4ANH are identical except for the maximum send level. The TTS 4AN has a maximum send level of +3 dbm, and the TTS 4ANH has a maximum send level of +10 dbm.

**1.06** The TTS 4AN series is supplied with an internally mounted regulated power supply which permits the use of the 48-volt station battery to power the set. The units are equipped with a jack marked 48V (located near the POWER switch). The third (down) position of the POWER switch substitutes the regulated supply for the internal set batteries.

**CAUTION:** The patch cord for the 48-volt operation must be inserted in the 48V jack on the test set **before** the other end is connected to the jack in the station jack field used to provide connections to the 48-volt station battery.

**1.07** The block diagram and overall wiring diagram are shown in Figs. 3 and 4.

**1.08** The set is contained in a grey finished aluminum case 8" wide by 11" long by 7" deep, with a detachable hinged cover. It weighs approximately 17 1/2 pounds. All batteries required for operation are contained within the case.

**1.09** This manual describes the TTS 4AN in detail. Unless specific mention is made of differences, it also applies to the TTS 4ANH.

## Oscillator

**1.10** The oscillator portion provides for sending individual tone frequencies of 200, 500, 1000, 1300, 1500, 2000, 2300, 2500, 3000, and 3500 cycles, selected by operation of the SEND FREQ switch. An additional position, marked EXT FREQ on the SEND FREQ switch can be used to trans-

fer the frequency determining circuits in the oscillator to a front panel connector socket marked EXT FREQ. Adapter units contained in special removable covers may be connected to this socket to provide additional frequencies for testing program circuits, FAA voice control circuits, etc. Output levels of 0, -5, -10, -16, -20, -25, -30, -35, and -40 dbm are selected by operation of the SEND LEVEL attenuator in the TTS 4AN. Output levels of +7, +3, 0, -5, -10, -16, -20, -25, -30, -35, and -40 dbm are selected in the TTS 4ANH by the same switch. By adjusting the CAL SEND control in the TTS 4AN until a meter reading of +3 dbm is obtained, a send level of +3 dbm may be obtained in the 0 db attenuator position. A send level of +10 dbm may be obtained by the same procedure in the TTS 4ANH, using the +7 db attenuator position.

**1.11** The maximum level variation when switching the self-contained send frequencies is less than 0.1 db, thus permitting a change of frequency without requiring a readjustment in oscillator level for each new frequency. The output of the oscillator is available at jacks designated LINE and SEND.

**1.12** The CAL SEND potentiometer is provided to adjust the send level of the set to the desired output level.

**Precision Termination**

**1.13** The set contains a precision 600 ohm +2 µf and 900 ohm +2µf termination.

**Amplifier and Level Meter**

**1.14** The receiving portion of the test set covers a range of levels from -50 dbm to +15 dbm. To provide 0 db meter readings for the commonly used carrier levels of +7 dbm and -16 dbm, the following REC ATTEN positions have been provided: +12, +7, +3, 0, -5, -10, -16, -20, -25, -30, -35, -40. When these attenuator positions are used in conjunction with the meter scale, graduated every 0.2 db from +3 to -3 db, accurate measurements can be made between +15 dbm and -43 dbm. By using the 1 db meter graduations from -3 db to -10 db, useful measurements can be made between -43 dbm and -50 dbm. Access to the receiving portion is accomplished by connecting to the jacks designated LINE and REC. An additional jack marked REC DIR gives direct access to the receive amplifier; use of this jack eliminates the receive transformer and thus extends the frequency range of the level measuring circuits. The REC DIR jack has 600 ohm impedance only; it has no DC blocking and **should not** be used on circuits carrying DC voltages. Input impedances of 600, 900, and 6000 ohms are available on both the TTS 4AN and TTS 4ANH sets by operation of the REC IMP key.

**1.15** The CAL REC adjustment is provided to calibrate the gain of the receiving amplifier.

**Talk, Monitor, Calibration, and Power Circuits**

**1.16** The test set contains an induction coil and internal talk batteries. TEL SET jacks are provided for insertion of a 52A or equivalent headset, thus permitting test personnel to send, receive, or talk on any line connected to the LINE jack by moving the LINE key to the desired position. A key designated LINE/MON, when in the OPEN position, opens the DC line circuit, thus creating an on hook condition for the talk circuit. In this

position a neon bulb, in series with a condenser, is connected across the line to indicate incoming ringing signals. The LINE/MON key has a third position marked MON AND 4W TALK which provides a transfer of the headset receiver to the amplifier output circuit to monitor the connection being measured. Operation of this key will not affect the meter indication. Two series connected LINE jacks are provided. The line under test is connected to one of these. A dial may be plugged into the second, unused jack. On 4-wire circuits the MON and 4W TALK positions connects the headset receiver to the receive amplifier, which in turn is connected to the receive leg of the 4-wire system. Acceptable receive levels in the headset are obtained by moving the RECEIVE ATTENUATOR switch until the desired level is obtained. The headset transmitter is connected to the line circuit and thus to the send leg of the 4-wire system, provided the LINE switch is in the TALK position.

**1.17** The FUNCTION switch, in the CAL SEND position, permits calibration of the send level by means of the CAL SEND control. In the CAL REC position it permits calibration of the amplifier gain by means of the CAL REC control. In both positions the control is adjusted to obtain a 0 db meter reading. Detailed calibration instructions are given in Section 4.0. The SEND REC position of the FUNCTION switch is used for all other operations of the set.

**1.18** The POWER key turns the set ON and OFF. A bracket in the cover operates the key to OFF before the cover is fully closed. The cover also provides space for storing cords. The standard cover can be removed and another cover, for instance one containing tuning elements to provide additional frequencies for the oscillator section, can be substituted. However, any cover which provides additional frequencies should only be used with the particular TTS 4AN or 4ANH with which it was factory aligned.

**Jack Strips and Pin Jacks**

**1.19** A number of jacks are located at the bottom of the front panel. An additional jack marked 48V is located near the POWER switch.

**SL** — A pin jack to the left of the jack strip provides a connection to the sleeves of both SEND jacks.

**TEL SET** — A twin jack to accept the plug of a 52A or equivalent headset connects to the talk circuits in the set.

**SEND** — Two cut-off type jacks in tandem, one accepting a 309 and the other a 310 plug, provide direct access to the LINE side of the balanced, DC blocked, output transformer. A hold coil with 125 ohms resistance is connected across the SEND jacks for the 600 and 900 ohm positions of the SEND IMP key switch. In the 600P position on this key switch the hold coil is removed to provide extended low frequency response for measurements on program lines.

**LINE** — Two jacks in series, one accepting a 309 and the other a 310 plug, provide the following: a 125 ohm DC resistance hold coil is connected across this circuit when the LINE/MON key is in the HOLD or MON position. In the SEND or REC position of the LINE switch impedances of 600

or 900 ohms are selected by the operation of the SEND IMP or REC IMP keys; in the REC position of the LINE switch an additional 6000 ohm input impedance is available. A telephone dial may be connected to the unused LINE jack to permit dialing test calls through the set.

**PRECISION TERMINATION** The set contains a precision 600 ohm +2μf and 900 ohm +2μf termination.

**CALL** A recessed neon bulb serves as an incoming ringing indicator when the LINE/MON key is in the LINE OPEN position.

**REC** A jack to accept a 310 plug provides direct access to the LINE side of the balanced, DC blocked, input transformer.

**REC DIR** A jack to accept a 310 plug provides direct access to the amplifier input attenuator. Using this jack the input transformer is by-passed to take advantage of the full frequency response of the REC amplifier. To avoid the need for recalibration, a pad equivalent to the transformer insertion loss is automatically inserted in the REC amplifier when this jack is used. DC voltages must NOT be applied to this jack.

**NMS** A jack to accept a 310 plug provides a direct connection to the LINE jack. A low resistance hold coil can be bridged across this jack under the control of the LINE/MON key. The amplifier input transformer and the amplifier circuits are disconnected when a plug has been inserted in this jack.

**SL** A pin jack to the right of the jack strip provides a connection to the sleeves of the LINE, REC, REC DIR, and NMS jacks.

**48V** This jack, located near the POWER switch, accepts a 310 plug and provides an input connection to the internal regulated power supply from the 48V station battery.

**Rack Mounted Sets**

**1.20** The rack mounted version of the TTS 4AN series is designated as the TTS 4ANHR. All these sets are equipped with +3.0 and +7.0 dbm send levels. They are designed for mounting in a 19" relay rack and use a vertical panel space of 8 3/4". The set extends 1 1/2" in front and 8" in back of the front panel. All the TTS 4ANHR sets are equipped with a dial. Mounting space is provided for an optional, continuously variable oscillator network to provide send frequencies of 20 cps to 20 kc. The code letter V should be added when ordering this feature, i.e., TTS 4 ANHRV. Circuits and features which have been changed as compared to the TTS 4AN and 4ANH are listed below. A block diagram of this set is shown in Fig. 3, the front panel in Fig. 2, and a more detailed diagram in Fig. 5.

**1.21** Two LINE jacks are provided in the rack mounted sets; one is a type 310 jack and the other a type 309-jack. The wiring of these jacks has been changed from the wiring used in the portable sets to provide

access to the LINE circuits of the test set through terminals on a terminal board in the rear; these are terminals 1 and 2 of TB2. This arrangement permits installation of permanent wiring which may, for instance, connect the TTS 4ANHR Test Set to a TN 40 Transmission Control Set; the TN 40 was specifically designed to facilitate loop around measurements with the TTS 4AN series of sets. Insertion of a plug into either the 309 or 310 LINE jack to the TTS 4ANHR will disconnect all circuits which are wired to the rear terminals. In the portable series of equipment these jacks are connected in series to permit insertion of an external dial in series with the test set. This feature has been eliminated in favor of a built-in improved dialing circuit.

**1.22** The pulsing contacts of the dial extend through the INT DIAL jack and the EXT DIAL jack to terminals 3 and 4 of TB2 and from there to the LINE switch S3. This connects the pulsing contacts in series with the hold coil and the talk circuit which are in parallel when the LINE switch is in the TALK position and are connected between tip and ring of the line circuit. Whenever the dial is moved from its normal position, its off normal contact shorts the hold coil, through a lead connected to terminal 5 of TB2, provided the LINE switch is in the TALK position. Access to the contacts of the built-in dial may be obtained by inserting a cord in the INT DIAL jack. By using the EXT DIAL jack, other dials may be used to perform the dialing operations. If the off normal contact of the external dial is not wired to the sleeve, the hold coil may be shorted by moving the TALK/EXT DIAL turnbutton switch to the EXT DIAL position. The EXT DIAL switch must always be left in the TALK position to use the talk circuit and for using the built-in dial. Failure to do so will short out the talk circuit.

**1.23** The receive circuits of the TTS 4ANHR which are connected to the REC jack are normally connected through disconnect springs on the REC jack, and on the NMS jack to the LINE switch, and through it to the LINE jacks, provided the LINE switch is in the REC position. These circuits are identical to those in the portable set. By moving the JACK-TB turnbutton switch to the TB position, access to the receive circuits can be obtained through terminals 9 and 10 of TB1 mounted in the rear of the unit. This makes it possible to install permanent wiring between the receive circuits of the TTS 4ANHR and external equipment such as the TN 40 Transmission Control Set.

**1.24** Moving the turnbutton switch to the TB position also connects a 600 ohm +2 mfd or 900 ohm +2 mfd termination across the disconnect springs of the NMS jack and thus to the LINE jacks, provided the LINE switch is in the REC position. This feature is used for measurements on 4-wire circuits where the LINE jack is used for the sending function; it applies a termination to the LINE jacks when the LINE switch is in the REC position. Insertion of a plug in the REC jack automatically disconnects the receive circuits from any circuits connected to the rear terminals.

**1.25** Mounting space is provided in the rear of this unit for three D cells which provide the talk battery and for nine 9-volt cells, type NEDA 2356. The 9-volt cells provide for 190 hours of service on an interrupted service basis. Switching to the internal battery provides a power source completely clear of all spurious signals which might exist on the 48-volt supply. In addition, the internal battery makes it possible to use the unit as a portable set. For this purpose a carrying case is available.

## 2.0 TRANSMISSION MEASURING PERFORMANCE

### Oscillator

**2.01** After a warm up period of 2 minutes, the output level of the oscillator will hold ±0.1 db for an ambient temperature of 60° to 80°F when changing any of the self-contained SEND frequencies. If the test set is used in an area in which the temperature varies from the above range, it should be recalibrated when changing frequencies by means of the CAL SEND and CAL REC control. In temperatures approaching freezing, the efficiency of the batteries drops rapidly and frequent recalibration is recommended. Table I gives a summary of the oscillator performance.

### TABLE I OSCILLATOR PERFORMANCE

At Room Temperature and for Fresh Batteries

### Oscillator

Frequency: Controlled by multi-position switch — 300, 500, 1000, 1300, 1500, 2000, 2300, 2500, 3000, 3500 cps. Different frequencies can be supplied on special order.

External Frequency Plug: A connector is provided on the panel for connecting external frequency determining networks.

Frequency Stability: Better than 1% from 50° to 100°F. Better than 2% from 30° to 120°F (factory adjustment 1/2% for 1000 cps).

Distortion: Less than 1% at any harmonic component.

Output Levels: Initial 0 dbm calibration by CAL SEND control with FUNCTION switch in SEND position and attenuators in CAL position. In the TTS 4AN fixed send levels are: 0, -5, -10, -16, -20, -25, -30, -35, and -40 dbm. In the TTS 4ANH fixed send levels are +7, +3, 0, -5, -10, -16, -20, -25, -30, -35, and -40 dbm. Additional send level adjustment between +3, and -3 db is available through the CAL SEND control for both units. To obtain send level settings which are different from those marked on the sent attenuator, proceed as per operating instructions, Appendix 1, Section B (d).

NOTE: It is necessary to follow this procedure because the meter was designed to track, i.e., to read db's above or below the 0 dbm reading correctly when it is used in connection with the receive amplifier; conversely, the meter will not track when it is connected directly to the oscillator.

Attenuator Accuracy: Better than 0.10 db.

Level Variation with Frequency: Less than 0.10 db for 60° to 80°F.

### Output Circuits

Output Impedance: Balanced output transformer with DC blocking; impedance selected by switch:

600 ohms ±5%, ±5° from 300 to 3500 cps
900 ohms ±5%, ±5° from 300 to 3500 cps

600P position:

600 ohms ±5%, ±5° from 75 to 3500 cps

Holding Coil: 125 ohms (274J or equivalent) on 600 and 900 ohm position; no hold coil on 600P position.

Output Connections:

On either 309 or 310 LINE jack when LINE switch is in SEND position.

On either 309 or 310 SEND jack irrespective of LINE switch position.

Precision Termination:

The set contains a precision 600 ohm +2μf and 900 ohm +2μf termination.

**Amplifier and Level Meter**

**2.02** The amplifier level meter combination will read signals to -43 dbm in -0.2 db divisions by using the attenuator and the scale markings between -3.0 and +3.0 db. Markings in 1 db steps from -3 to -10 dbm and a mark at -20 dbm make it possible to measure lower signal levels at reduced accuracy. The dynamic characteristics of the meter are identical to those of a VU meter; therefore, the Model TTS 4AN can be used for VU measurements. In addition, a red arc covering levels below -6 db and a green arc covering levels above 0 db are provided for this application. With a 52A headset plugged into the jacks marked TEL SET, operation of the LINE/MON key to the MON position makes it possible to monitor the amplifier output without upsetting the meter reading. Table II gives a summary of the amplifier and level meter performance.

**TABLE II AMPLIFIER AND LEVEL METER PERFORMANCE**

At Room Temperature and for Fresh Batteries

**Input Circuits**

1. On either 309 or 310 LINE jack when the LINE switch is in the REC position. In this circuit a DC blocked, balanced transformer is provided and a 125 ohm hold coil (274J or equivalent) is provided under the control of the LINE/MON switch.

2. On the 310 REC jack no hold coil is provided in this connection; however, a DC blocked, balanced transformer is provided.

3. On the 310 REC DIR jack direct access to the amplifier is provided through the amplifier input attenuator and a fixed pad matching the input transformer insertion loss.

   CAUTION: The REC DIR input has no DC blocking; to prevent internal damage, this input must NOT be used in circuits carrying DC voltages.

4. On the 310 NMS jack a direct connection to the LINE jack is provided. A 125 ohm hold coil is provided on this circuit under the control of the LINE/MON switch.

Input Impedance: Balanced input transformer with DC blocking. Impedance selected by switch, 600, 900, 6000 ohms. Impedance is 600 or 900 ohms, ±5%, ±5° over the frequency range from 100 to 5000 cps, except for the LINE input, where the hold coil causes a 7° phase angle at 300 cps.

**Amplifier**

Frequency Response: Variations from 1000 cps at 70°F.

1. Through balanced transformer:

   a) LINE jack
   With hold coil, 600 or 900 ohms
   Variation: less than 0.1 db from 300 to 8000 cps
   less than 0.2 db from 200 to 10,000 cps

   b) REC jack
   Without hold coil, 600 or 900 ohms
   Variation: less than 0.1 db from 100 to 8000 cps
   less than 0.2 db from 75 to 15,000 cps

   c) REC jack
   Bridging, 6000 ohms
   Variation: less than 0.1 db from 150 to 5000 cps
   less than 0.2 db from 75 to 10,000 cps

   Note: There is a 20 db reduction in sensitivity in the bridging position.

2. Direct input through REC DIR jack, 600 ohms
   Variation: less than 0.2 db from 20 to 20,000 cps

3. Frequency response errors for all self-contained send frequencies can be eliminated by using the self-calibrating procedure described in Section 4.0.

4. Amplifier frequency response is virtually independent of temperature.

Receive Levels: Receive levels of +12, +7, +3, 0, -5, -10, -16, -20, -25, -30, -35, and -40 will produce a 0 dbm reading on the meter scale for either 600 or 900 ohms input impedance, provided the attenuator has been moved to the corresponding position. By using the 1 db meter calibration points, levels from -43 to -50 dbm may be read at reduced accuracy; an additional mark corresponding to -60 dbm is provided. When the 6000 ohm input impedance (marked bridging) is used, the sensitivity of the set is reduced by 20 db. An accessory amplifier can be supplied to eliminate this loss.

Attenuator Accuracy: Better than 0.10 db.

**Meter**

Range: —20 to +3 db.

Scale: Mirror scale, marked in 0.20 db steps from -3.0 to +3.0 db; 1 db steps from -3.0 to -10; an additional mark at -20 db is provided. Scale marks and numbers above 0 db are colored red. For VU measurements an extra arc colored green between 0 and +3 db and

an extra arc colored red from -6 db to the meter 0 are provided. These arcs can be deleted on special order.

Accuracy:

Better than ±0.15 db from -3.0 to +3.0 db from 60° to 90°F.
Better than ±0.25 db from -3.0 to +3.0 db from 30° to 120°F.
Representative production sets show accuracies of ±.05 db or better over the range of -3.0 to +3.0 db.

Variation with Frequency: None up to 20 kc (error is -0.15 db at 50 kc).
Dynamic Characteristics: Identical to VU meter.
Adjustable Shunt: All TTS 4AN and 4ANH sets are equipped with a meter which has an adjustable magnetic shunt. This permits small adjustments of the meter sensitivity. If the meter shows minor deviations from a 0 dbm reading when inserted in a suitable 0 dbm test circuit, adjustment of this shunt makes it possible to obtain the correct 0 dbm meter reading.

**Batteries**

**2.03** The oscillator uses two 9-volt Eveready 226 or equivalent batteries connected in series for 18 volts. For sets used with the continuously variable frequency attachment, six cells for series/parallel operation at 27 volts are provided. The buffer amplifier in the TTS 4AN uses one 9-volt Eveready 226 or equivalent battery. The buffer amplifier in the TTS 4ANH uses four 9-volt Eveready or equivalent batteries. The talk circuit uses three 1.5 volt D cells, Eveready 950 or equivalent. The amplifier circuit uses two 9-volt Eveready 226 or equivalent batteries in parallel. Battery life (excluding the talk circuit) should readily exceed 75 hours on an intermittent use basis; continuous operation substantially reduces battery life. Note that battery output voltage drops materially at temperatures below approximately 45°F. As a result, although the circuits operate properly at temperatures down to 30°F and below, the overall set performance will be affected in prolonged use at low temperatures. For this type ofservice special batteries are required.

## 3.0 CIRCUIT DESCRIPTION

### Amplifier (Fig. 6)

**3.01** The amplifier uses two stages of common emitter amplification and an emitter follower. An overall negative feedback circuit providing approximately 15 db of negative feedback and consisting of resistors R9 and R31 is used to center the range of the last emitter. Resistor R31 is used to center the range of the CAL REC variable attenuator consisting of variable resistors R30 (dual potentiometer) and fixed resistors R36 and R34. This is a factory adjustment and does not require readjustment. R36 is a fixed resistor which equals the input impedance of the amplifier which appears in parallel with fixed resistor R34. The value of R8 determines the output impedance of the amplifier and controls the accuracy with which the meter indications follow input level variations above and below the 0 dbm indication. To suit the impedance characteristics of different groups of meters, slightly different values of R8 may be used during the process of factory adjustment. A thermistor from the base of Q6 to ground provides the correct bias for this stage over a wide temperature range. The input impedance to the amplifier can be adjusted to exactly 600 ohms for optimum accuracy by means of R32. The output level can be varied over at least a -0.30 to +1.20 db range by the adjustment of CAL REC control R30.

### Oscillator and Buffer Amplifier ( Fig. 7 )

**3.02** The bridged-T oscillator uses three transistor stages. The first two are direct coupled from the collector of Q1 to the base of Q2. The positive feedback path is completed from the emitter of Q2 back through a tungsten bulb, used for level stabilization, to the emitter of Q1. The emitter resistor of Q1 is variable for setting the correct amount of positive feedback necessary for stable operation. A negative feedback which is greater than the positive feedback is supplied to the base of Q1 through a null selective network and an emitter follower. The selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation to occur at the desired frequency, which is determined by the values in the bridged-T circuit. This frequency determining network consists of two padded capacitances, C19, C23, and C20, C22, and two resistors selected by the frequency selector switch S9. In the EXT position of the frequency selector switch condensers C19, C23, C20, and C22, are removed from the circuit.

**3.03** The buffer amplifier is a single transistor in a common emitter circuit. The oscillator voltage obtained at the emitter of Q2 is AC coupled to R40 through R18. The high side of R40 is connected to the base of Q4, the low side to ground through R20. This arrangement permits a fine adjustment of the output level over a range of 6 db. The collector load is AC coupled to the output circuit, which consists of the attenuator and output transformer.

### 48-Volt Power Supply ( Figs. 8, 9, 10 )

**3.04** The internally mounted unit is a regulated supply using zener diode CR-2 as a voltage reference, transistor Q8 as a voltage amplifier, and power transistor Q9 as the control element. The output of this regulator supplies power to the amplifier through a voltage divider and to the oscillator and buffer stages through series resistors. Rectifier CR-101 prevents damage

to the circuit when reversed voltage is erroneously applied to it. The talk circuit power is not regulated. It is supplied through dropping resistor R1 and filter condenser C1.

**3.05** The switching of the amplifier, oscillator, and buffer circuits to either internal supply or 48-volt external supply is shown in Fig. 8.

## 4.0 CALIBRATION

**4.01** The calibration procedure is simple and can be performed by following instructions printed on the front panel. Both attenuators should be placed in the 0 db position; this position is marked 0 ( CAL ). The circuits used in the calibration procedure are shown in Figs. 3 and 4.

**4.02** With the FUNCTION switch in the CAL SEND position the meter is connected directly to the 600 ohm tap on the balanced transformer in the oscillator section, irrespective of the position of the SEND IMP switch; the hold coil is eliminated in this circuit. The CAL SEND control in the oscillator is adjusted until the meter reads 0 dbm. The oscillator section will now deliver a 0 dbm level accurate within ±0.05 db into any 600 ohm load connected to the 600 ohm output taps or into a 900 ohm load connected to the 900 ohm output tap when the SEND IMP switch is in 600 or 900 ohms. Greater accuracy can be obtained at 600 ohms by setting the SEND IMP switch in the 600P position; however, the hold coil is not connected in this position of the SEND IMP switch.

**4.03** With the FUNCTION switch in the CAL REC position the 0 dbm, 600 ohm oscillator output is connected directly to the 600 ohm taps of the input transformer of the amplifier level meter section. This 600 ohm connection again eliminates the hold coil and is independent of the position of the SEND IMP and REC IMP switches. The CAL REC control is now adjusted until the meter reads 0 dbm. The gain of the amplifier is now normalized.

## 5.0 OPERATION

**5.01** For procedures to be followed in the operation of the TTS 4AN series of sets refer to Appendix 1. Procedures for using the external accessories, which are available in detachable covers for the TTS 4AN series of sets, are described in separate appendices.

## 6.0 MAINTENANCE

**6.01** All of the 9-volt batteries should be replaced when either of the following is observed:

1. During CAL SEND the maximum level on the meter is below **+0.75 db.**
2. During CAL REC the maximum level on the meter is **+0.30 db** or less.

**6.02** With a 52A headset plugged into the TEL SET jacks, power ON, LINE switch in TALK position, LINE/MON switch on HOLD, blow lightly into the mouthpiece; if the sound is not heard distinctly in the earphones, check to insure the D cells are making good contact in their holders and, if necessary, replace the three D cells.

**6.03** All batteries can be replaced by loosening the four captive panel screws and lifting the test set out of the case.

### Cleaning Jack and Switch Contacts

**6.04** If the reading on the meter fluctuates continually at any time in operation, turn the FUNCTION switch first to the CAL SEND and then to the CAL REC position. If the reading still fluctuates in these positions, check for weak batteries. If the batteries are normal, proceed as follows:

1. Remove the test set from its case and set it carefully upside down.
2. Take a small brush and dip it in Triclene or equivalent and clean all jack contacts.
3. If Step 2 does not clear up the trouble, clean all switch contacts.

### Shop Maintenance

**6.05** The adjustments described below should only be attempted in a well equipped laboratory and by qualified personnel. The general location of the major parts in the TTS 4AN are shown in Fig. 11. Data on the wiring of the switches used in this set are shown in Figs. 14, 15, 16, and 17. Overall wiring of the set is shown in Figs. 4, 5, and 8, and the locations of the connections and test points on the printed circuit board are shown in Figs. 12 and 13.

### Oscillator

**No Output or Fluctuating Ouput at the SEND Jacks**

**6.06** Check batteries, if this has not already been done (see Section 6.01), and DC voltages shown in Section 7.0.

**6.07** Connect a milliammeter in series with one of the leads to the 18-volt supply in the oscillator section. Normal current for this section is 10 ma ±20%. (If the current is outside these limits, turn the power off and locate the trouble.) Refer to Fig. 13 and connect the high side of a VTVM to point A and the low side of point C of the printed circuit board. The voltage should be 1.55 volts RMS at these points. If it is not, adjust R41 for this level. Turning R41 with a screwdriver counter clockwise increases the positive feedback and therefore increases the output level at points A

and C. The fluctuation in the output level should cease when the output level at points A and C is 1.55 volts RMS.

**6.08** If there is no level or a fluctuating level at points A and C with R41 in maximum counter clockwise position, remove the tungsten bulb and check the filaments for continuity. Replace if faulty. If the bulb is good, reinstall, and replace transistors, starting with Q1 and ending with Q4, until the oscillator is operative and stable. Before installing a new bulb, age it first by operating it at 115 volts for one hour. If the bulb has been replaced it is necessary to reset the oscillator level at points A and C for 1.55 volts RMS. For models equipped with a TTS 4XV or TTS 4XDV cover, voltage at points A and C should be 1.8 volts RMS.

**Distortion**

**6.09** Adjust R41 for 1.55 volts at points A and C (or 1.8 volts for sets with a TTS 4XV or 4XDV cover), and measure the harmonic distortion at the SEND jack. Any harmonic of the fundamental frequency should not exceed 1% (down 40 db) of the fundamental level. If the distortion exceeds this requirement, check the batteries or trace and replace the transistor causing this condition.

**Frequency Accuracy**

**6.10** Frequencies should be within ±1% of their indicated values at room temperature and for fresh batteries. Measure all frequencies and note whether they are either all high or low. If they are all high, increase the capacitance equally at C19-23 and C20-22. If all frequencies are low, decrease in equal amounts the capacitance of C19-23 and C20-22. Normally only small amounts of capacitance changes are involved (30 to 100 mmfd) if frequencies are found to be in error.

NOTE: It is important that **equal** amounts of capacitance be added or removed at C19-23 and C20-22. If only one or two frequencies are found to be in error, the resistor or resistors involved should be replaced. After correcting any frequency problem, be sure to check the level stability. The level should not change more than ±0.10 db with changes in frequency.

**Buffer Amplifier** (see circuit diagram in Fig. 7)

**6.11** Connect a 600 ohm load to the SEND jacks and set the SEND IMP switch at 600 ohms. Insert a milliammeter in series with a battery lead going to the buffer amplifier circuit. The current should be 6 ma ±30% for a TTS 4AN and 14 ma ±30% for a TTS 4ANH. Connect the high side of the VTVM to point B and the low side to point C. With the CAL SEND ADJ fully clockwise, the level should be 1.1 volts RMS ±20% for a TTS 4AN and 2.75 volts RMS ±20% for a TTS 4ANH. Replace Q4 if these specifications are not met. The harmonic distortion should be under 1% at any frequency. Replacement of Q4 in the buffer amplifier requires checking of the output impedances at the SEND jacks. The SEND IMP switch should be in the 600 ohm position and the SEND LEVEL in the 0 (CAL) position for the TTS 4AN and in the +7 position for the TTS 4ANH. Disable the oscillator by disconnecting the leads to the oscillator battery supply and turn the power ON. By using an impedance bridge the output impedance

can be checked. The output impedance can be varied by adjusting R42. The output impedance should be 600 ohms ±5% with not more than 5° phase shift over the range indicated in Table 1.

**Amplifier and Level Meter**

**No Meter Indication When on CAL REC, or When a Known Level is Ap-Applied to the REC Jack**

**6.12** Check batteries as per paragraph 6.01 or check the DC voltages shown in Table III, Section 7.0.

**6.13** Connect a milliammeter in series with one of the leads to the 9-volt supply in the amplifier section. Normal current flow for this section is 10 ma ±20%. (If the current is outside these limits, turn power off and locate trouble.) Connect a VTVM across the amplifier input, i.e., points R and S in Figs. 6 and 12. Turn REC LEVEL to 0 (CAL). Apply a 0 dbm, 1 kc signal from a 600 ohm generator to the REC jack. The level at the VTVM should read -40 db. If it does not, refer to the overall schematic (Figs. 3 and 4), and locate the trouble by the following method. Disconnect the VTVM from the printed circuit board and use it to test progressively from the REC jack to the printed circuit board, and locate the point where the signal is lost. Re-establishing the -40 db level to the printed circuit board should make the amplifier operative. If the VTVM at the amplifier input measures -40 dbm, trace through the amplifier to locate the defective transistor or component.

**Input Impedance**

**6.14** The input impedance can be checked by the substitution method at the REC jack. Turn power on and the REC level to -40 db. If necessary, R32 should be adjusted to give exactly 600 ohms input. When it is desirable to measure impedance and phase angle of the set over the frequency range of 100 cps to 8 kc, it can be done on the LINE or REC jacks with the REC LEVEL at 0 (CAL) and the power OFF.

**Meter Tracking with Level Changes**

**6.15** Connect a precision, 600 ohm, unbalanced attenuator (with steps of 1.0 db and an accuracy of not less than .05 db) between a 600 ohm oscillator (1 kc) and the REC jack of the test set. Complete the calibration of the test set per page 1 of Appendix 1. Adjust the level of the 1 kc generator for exactly 0 db on the level meter in the test set. Now vary the precision attenuator in 1.0 db steps from a meter reading of 0 db to -3 db and then to +3 db. The meter reading should follow the changes in the precision attenuator setting within ±0.10 db. If the meter does not track, replace transistor Q6. If this does not provide proper tracking, replace R8 with any value in the 0 to 120 ohm range which will produce proper tracking. If transistors have been replaced, the frequency response of the amplifier should be remeasured to be sure that the changing of the transistors has not adversely affected the frequency characteristics of the amplifier.

**Meter Calibration**

**6.16** All the TTS 4AN and 4ANH sets are equipped with a meter which

has an adjustable magnetic shunt. This permits small adjustments of the meter sensitivity. If the meter shows minor deviations from a 0 dbm reading when inserted in a suitable 0 dbm test circuit, adjustment of this shunt makes it possible to obtain a correct 0 dbm reading. With the POWER switch in the OFF position, check the mechanical zero of the meter. If correction is needed, a small adjustment can be made to the mechanical zero screw on the face of the meter.

**6.17** A 0 dbm test circuit can be obtained by adjusting an oscillator so that it has 1.5492V ±5MV on its terminals and connecting the meter under test to these terminals through a 600 ohm precision non-inductive resistor. During the calibration of the meter the two leads normally connected to the meter are removed and connections to the test circuit are made directly to the meter terminals. It is not necessary to dismantle the set to adjust the magnetic shunt; a long screwdriver can be inserted from the rear of the set to make this adjustment. An insulated sleeve should be slipped over the screwdriver to avoid short circuits, and glyptol should be applied to the adjustment to lock it in place after the readjustment is completed.

## 7.0 POWER SUPPLY

### 7.01 Internal Batteries — Amplifier Section

Table III applies to the amplifier section of all Model TTS 4AN and 4ANH tests sets.

**TABLE III REPRESENTATIVE DC VOLTAGES**

| | Emitter | Collector | Current Drain |
|---|---|---|---|
| Amplifier Q5 | .08 | 2.75 | |
| Q6 | .06 | 4.60 | 10 MA |
| Q7 | 4.50 | 9.0 | |

### 7.02 Internal Batteries — Oscillator Section

Table IIIA applies to the oscillator section of the TTS 4AN and 4ANH sets when these sets are used without a TTS 4XV or TTS 4XDV accessory cover.

**TABLE IIIA REPRESENTATIVE DC VOLTAGES**

| | Emitter | Collector | Current Drain |
|---|---|---|---|
| Oscillator Q1 | 1.12 | 11.0 | |
| Q2 | 11.0 | 18.0 | 10 MA |
| Q3 | 9.60 | 18.0 | |

**7.03** Table IIIB applies to the oscillator section of the TTS 4AN and 4ANH sets when they are equipped with TTS 4XV or TTS 4XDV accessory covers.

**TABLE IIIB REPRESENTATIVE DC VOLTAGES**

| | Emitter | Collector | Current Drain |
|---|---|---|---|
| Oscillator Q1 | 1.55 | 18.5 | |
| Q2 | 18.0 | 27.0 | 17 MA |
| Q3 | 6.20 | 27.0 | |

### 7.04 Internal Batteries — Buffer Amplifier

Table IIIC applies for the buffer amplifier in the TTS 4AN and 4ANH sets.

**TABLE IIIC REPRESENTATIVE DC VOLTAGES**

| | Emitter | Collector | Current Drain |
|---|---|---|---|
| TTS 4AN Q4 | 1.10 | 5.20 | 6 MA |
| TTS 4ANH Q4 | .70 | 8.0 | 14 MA |

**7.05** The voltages listed above were measured after the set was operating for five minutes at room temperature ( 70 °F ), and with new batteries.

### 7.06 Minimum Battery Operating Voltages

Batteries should be replaced if their voltage under load at room temperature (70°F) falls below the minimums specified below, or as stipulated under Section 6.01.

**TABLE IV BATTERY VOLTAGES**

| Circuit | Minimum Operating Voltage | New |
|---|---|---|
| Amplifiers | 7.5 volts | 9.0 volts |
| Oscillator (Note 1) | 10.0 volts | 18.0 volts |
| Oscillator (Note 2) | 18.0 volts | 27.0 volts |
| Buffer | 5.5 volts | 9.0 volts |
| Talk Circuit | 3.0 volts | 4.5 volts |

Note 1 — For sets not using the TTS 4XV or TTS 4XDV accessory cover.
Note 2 — For sets using the TTS 4XV or TTS 4XDV accessory cover.

### 7.07 External 48-volt Operation — All Series TTS 4AN Sets

The total current drain for these units is 100 MA with all circuits in operation. When the unit is running without the TALK circuit operating, total current drain is 70 MA.

CAUTION: When patching any of the TTS 4AN series to the station battery it is necessary to patch to the 48-volt jack on the test set **first**, then patch to the station battery. Also, when removing the set from a station battery, withdraw the patch cord from the battery supply **first**.

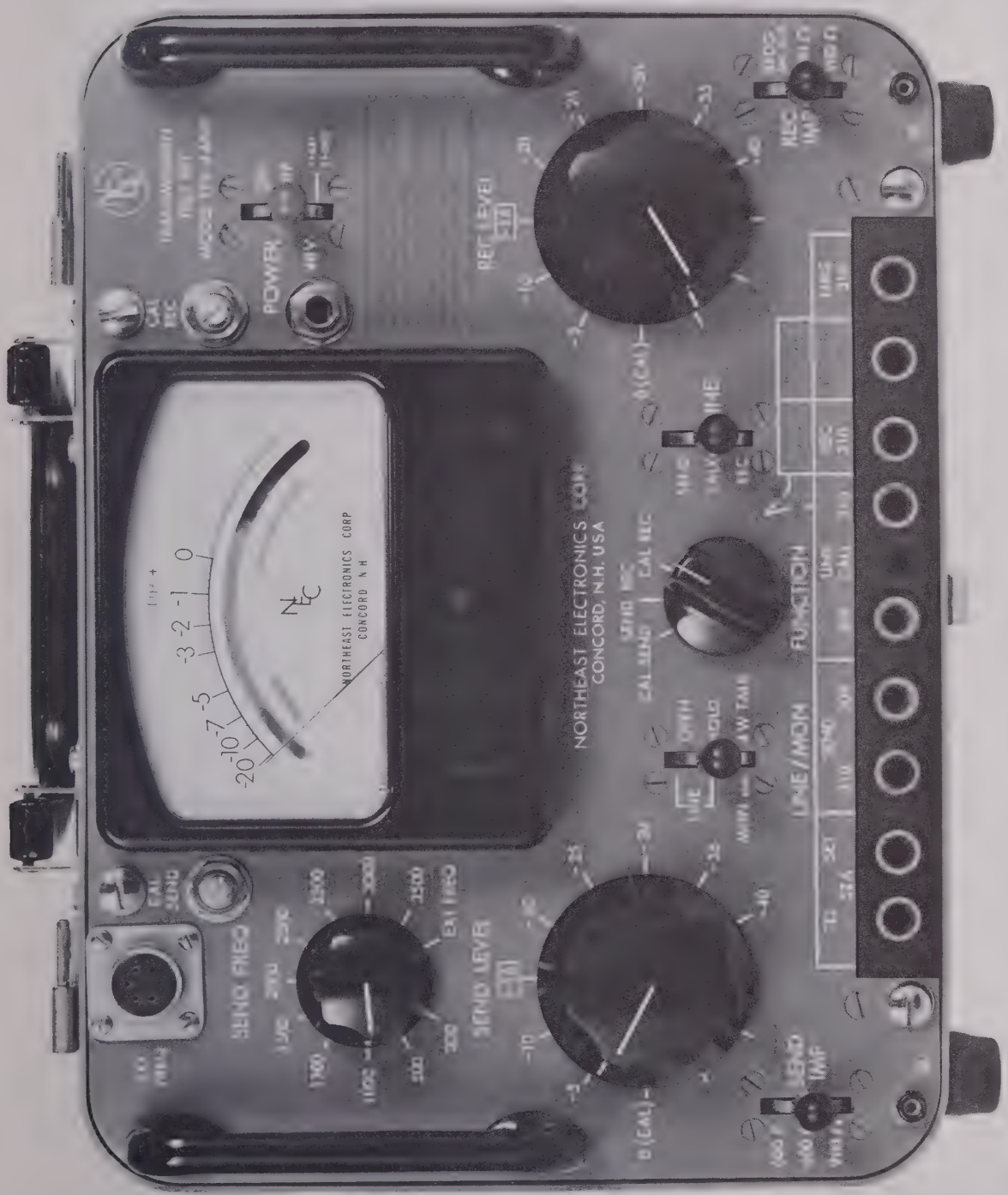

POWER
REF LEVEL
NORTHEAST ELECTRONICS CORP
CONCORD, N.H. USA
SEND FREQ
SEND LEVEL
LINE/MON
FUNCTION
CAL SEND
CAL REC
LINE
HOLD
REC IMP
SEND IMP

FIG. 1

NORTHEAST ELECTRONICS CORP
CONCORD, N.H. U.S.A.
SEND REC
CAL SEND CAL REC
OPEN
HOLD
LINE
MON AND
SEND LEVEL
VFO FREQUENCY
S-SCALE
ABC
DEF
PRS
TUV
WXY
MNO

FIG. 2

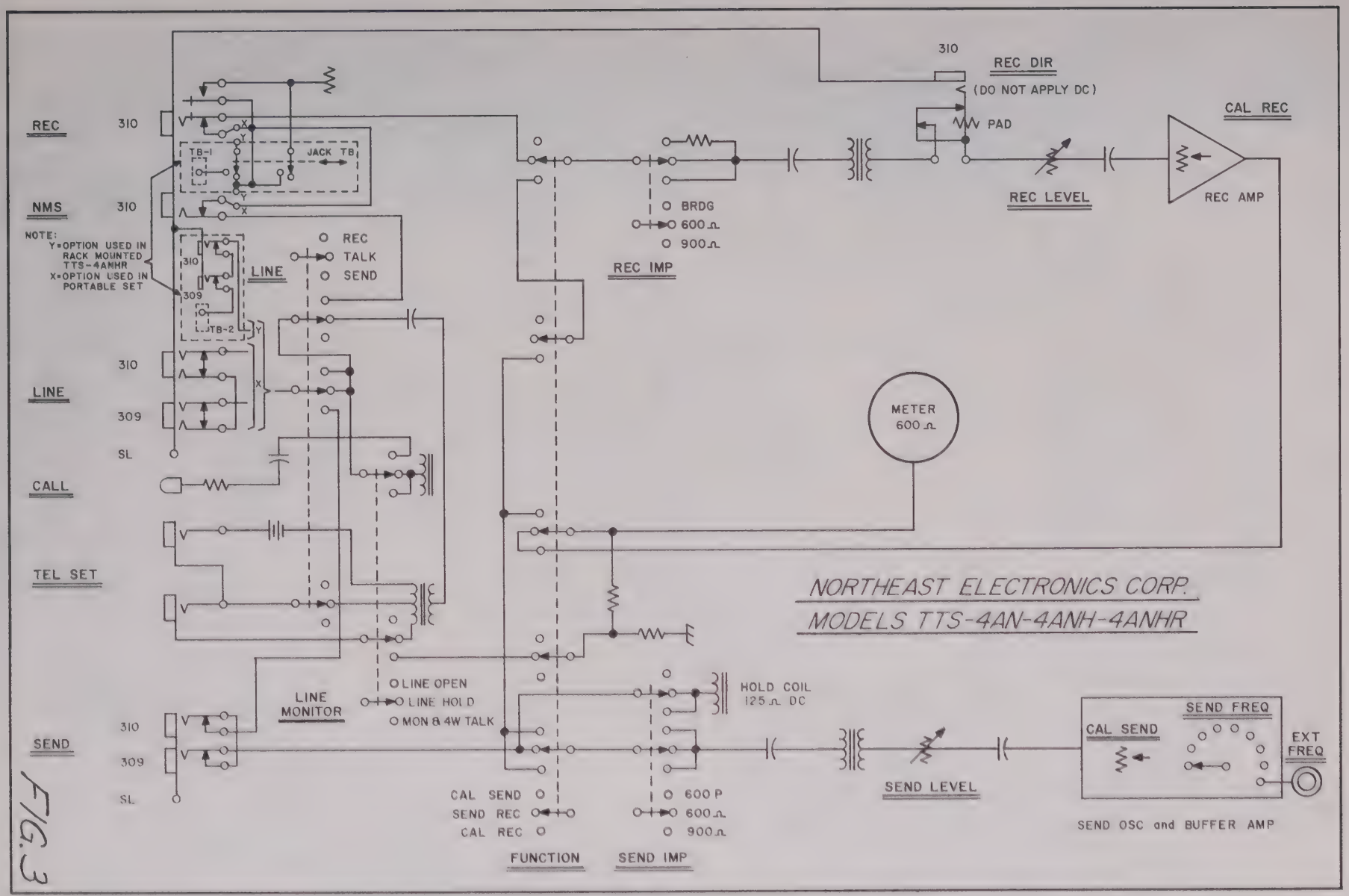
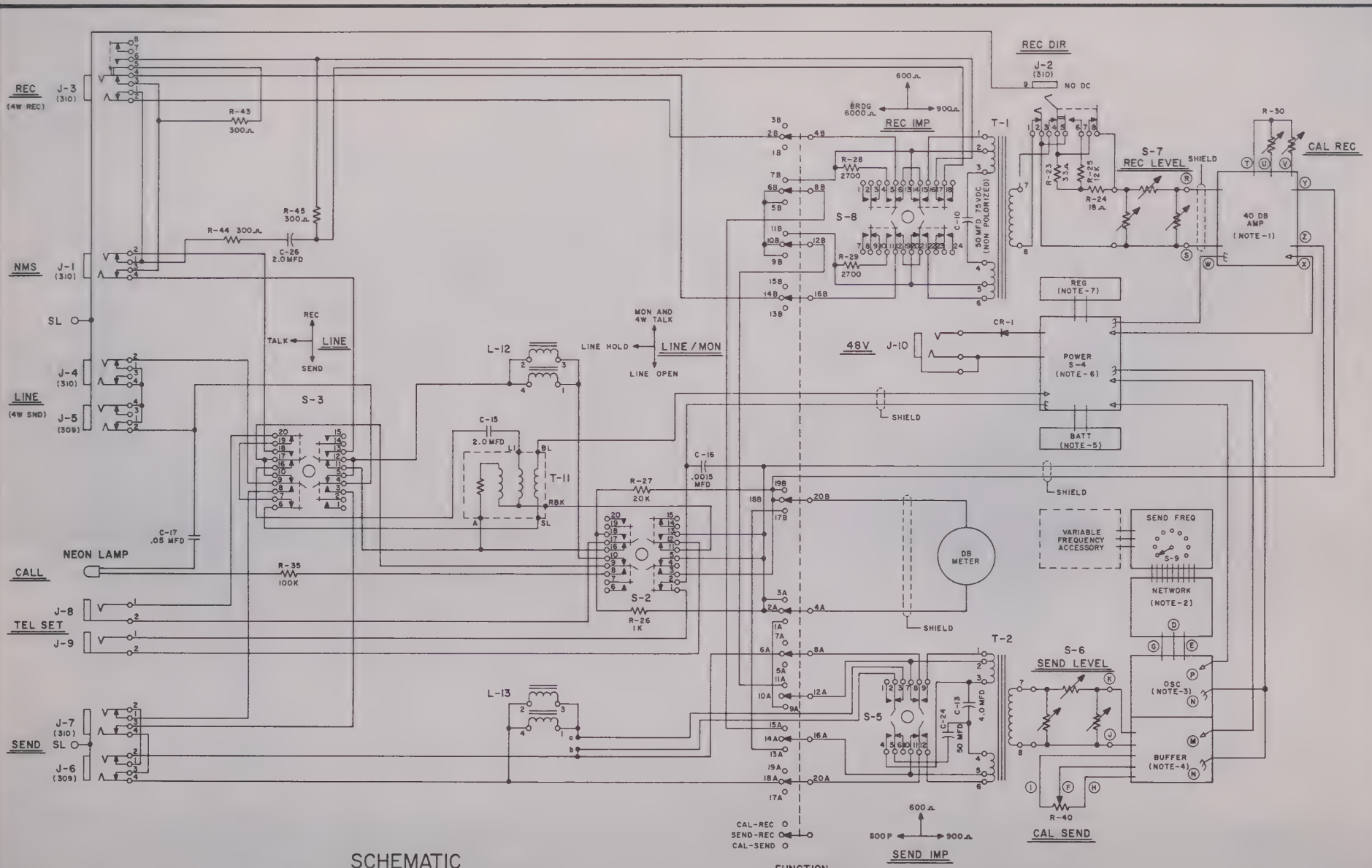

REC
NMS
LINE
CALL
TEL SET
SEND
310
309
SL
TB-1
JACK TB
TB-2
NOTE:
Y=OPTION USED IN RACK MOUNTED TTS-4ANHR
X=OPTION USED IN PORTABLE SET
REC
TALK
SEND
LINE
REC DIR
(DO NOT APPLY DC)
PAD
REC LEVEL
CAL REC
REC AMP
BRDG
600Ω
900Ω
REC IMP
METER
600Ω
LINE OPEN
LINE HOLD
MON & 4W TALK
LINE MONITOR
HOLD COIL
125Ω DC
CAL SEND
SEND REC
CAL REC
FUNCTION
600P
600Ω
900Ω
SEND IMP
SEND LEVEL
SEND FREQ
CAL SEND
EXT FREQ
SEND OSC and BUFFER AMP
NORTHEAST ELECTRONICS CORP.
MODELS TTS-4AN-4ANH-4ANHR

FIG. 3




SCHEMATIC
MODEL TTS-4AN/H SERIES
NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.
U. S. A.

REV. 2
FIG. 4

NOTE 1
AMP. OSC. AND BUFFER ARE ON COMMON P. C. BOARD REPRESENTED BY BLOCKS IN ABOVE DIAGRAM.

NOTE 2
NETWORK IS ON A SEPARATE COMPONENT BOARD.

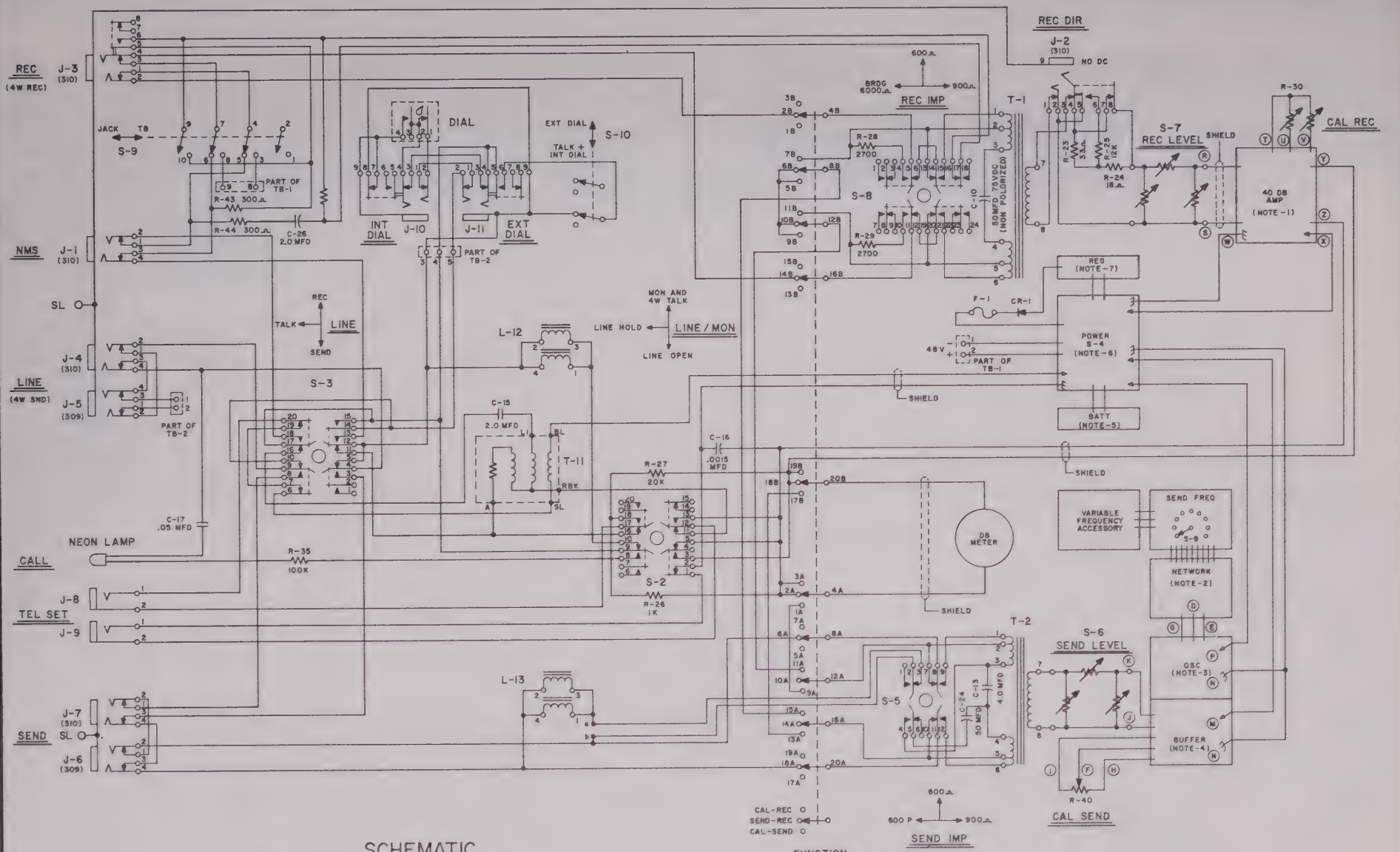
NOTE 3
18V FOR SETS WITHOUT VFO.
27V FOR SETS WITH VFO.

NOTE 4
9V FOR AN SETS.
18V FOR ANH SETS.

NOTE 5
CELLS ARE EVEREADY 226 OR EQUIVALENT AND THREE 1 1/2V D CELLS IN PORTABLE SETS.

NOTE 6
SEE FIG. 5 FOR S-4 SWITCH DETAIL.

NOTE 7
SEE FIG. 6 FOR 48V REG. SCHEMATIC.




# SCHEMATIC
# MODEL TTS-4ANHR/V SERIES
# NORTHEAST ELECTRONICS CORP.
# CONCORD, N. H.
# U. S. A.

REV. 3
FIG. 5

NOTE 1
AMP, OSC. AND BUFFER ARE ON COMMON P.C. BOARD REPRESENTED BY BLOCKS IN ABOVE DIAGRAM.

NOTE 2
NETWORK IS ON A SEPARATE COMPONENT BOARD.

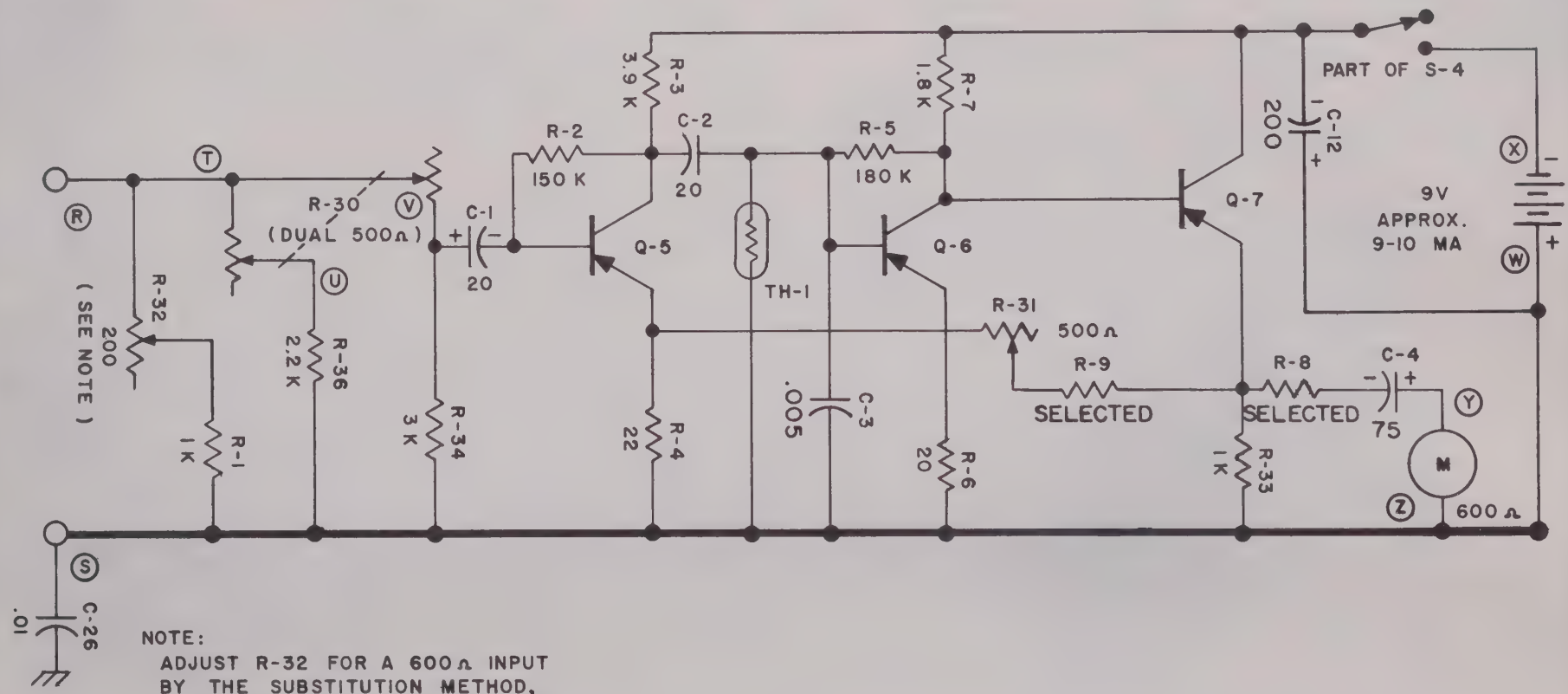
NOTE 3
18V FOR SETS WITHOUT VFO.
27V FOR SETS WITH VFO.

NOTE 4
9V FOR AN SETS.
18V FOR ANH SETS.

NOTE 5
CELLS ARE EVEREADY 226 OR EQUIVALENT AND THREE 1 1/2V D CELLS IN PORTABLE SETS.

NOTE 6
SEE FIG. 5 FOR S-4 SWITCH DETAIL.

NOTE 7
SEE FIG. 6 FOR 48V REG. SCHEMATIC.

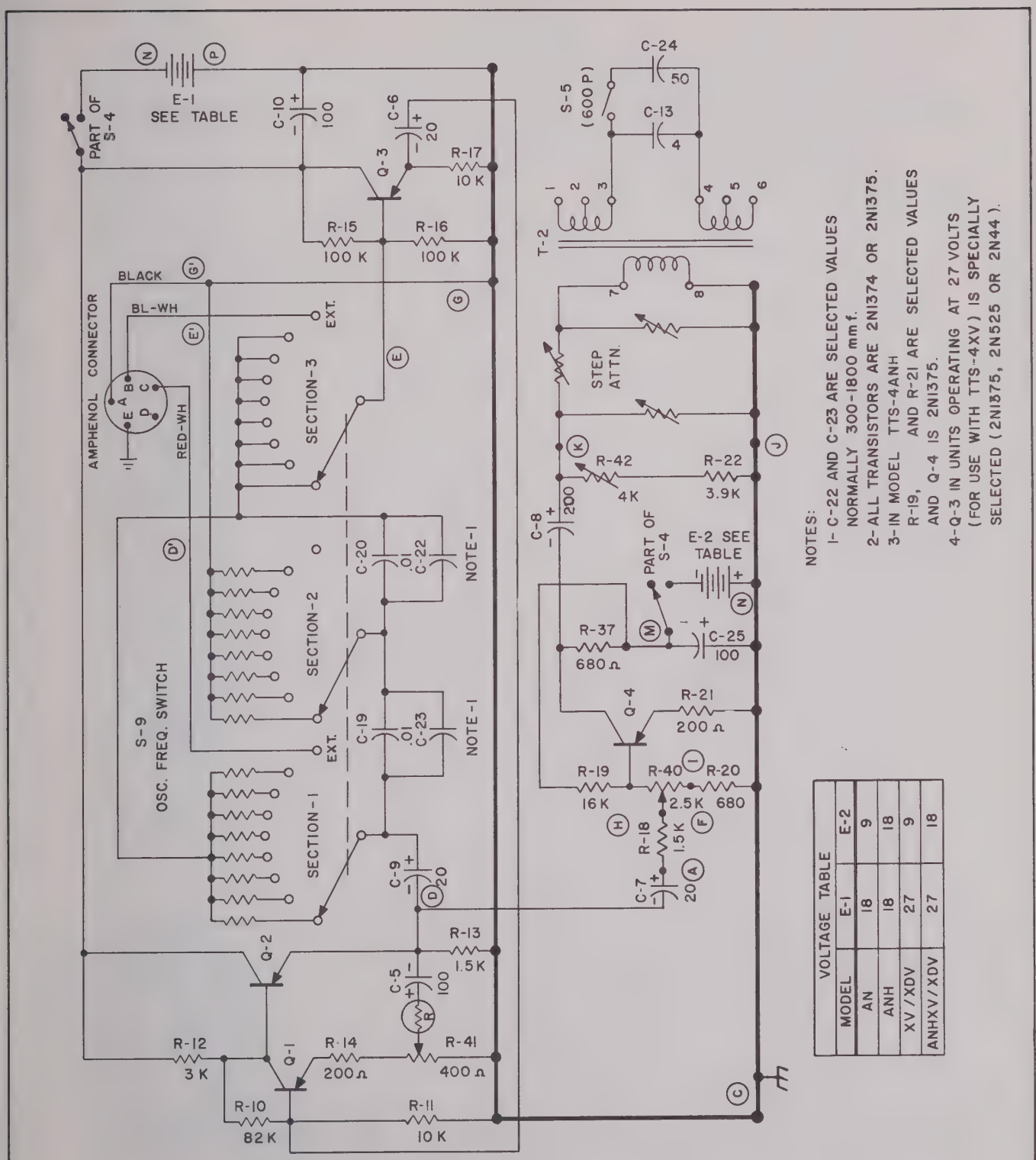



NOTE:
ADJUST R-32 FOR A 600Ω INPUT BY THE SUBSTITUTION METHOD, WITH POWER ON AND REC-LEVEL ON 40 DB.

ALL TRANSISTORS 2N1374 OR 2N1375

## SCHEMATIC – AMPLIFIER
## MODEL TTS-4AN/ANH ANHR/V
## NORTHEAST ELECTRONICS CORP.
## CONCORD, N.H.

Fig. 6



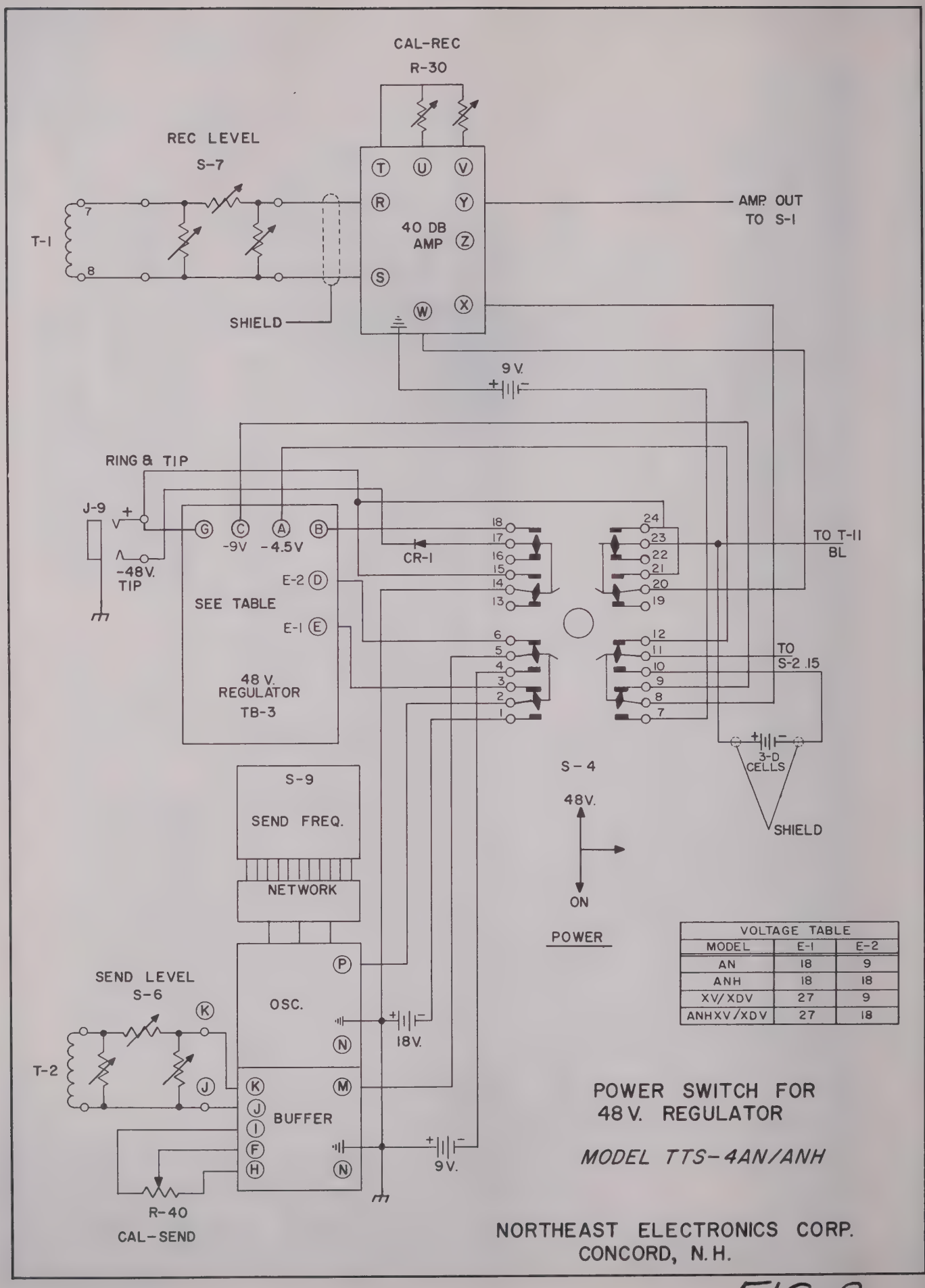

NOTES:
1- C-22 AND C-23 ARE SELECTED VALUES NORMALLY 300-1800 mmf.
2- ALL TRANSISTORS ARE 2N1374 OR 2N1375.
3- IN MODEL TTS-4ANH R-19, AND R-21 ARE SELECTED VALUES AND Q-4 IS 2N1375.
4- Q-3 IN UNITS OPERATING AT 27 VOLTS (FOR USE WITH TTS-4XV) IS SPECIALLY SELECTED (2N1375, 2N525 OR 2N44).

VOLTAGE TABLE

| MODEL | E-1 | E-2 |
|---|---|---|
| AN | 18 | 9 |
| ANH | 18 | 18 |
| XV / XDV | 27 | 9 |
| ANHXV / XDV | 27 | 18 |

SCHEMATIC – BRIDGED-T OSC.
MODEL TTS-4AN/ANH
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

FIG. 7



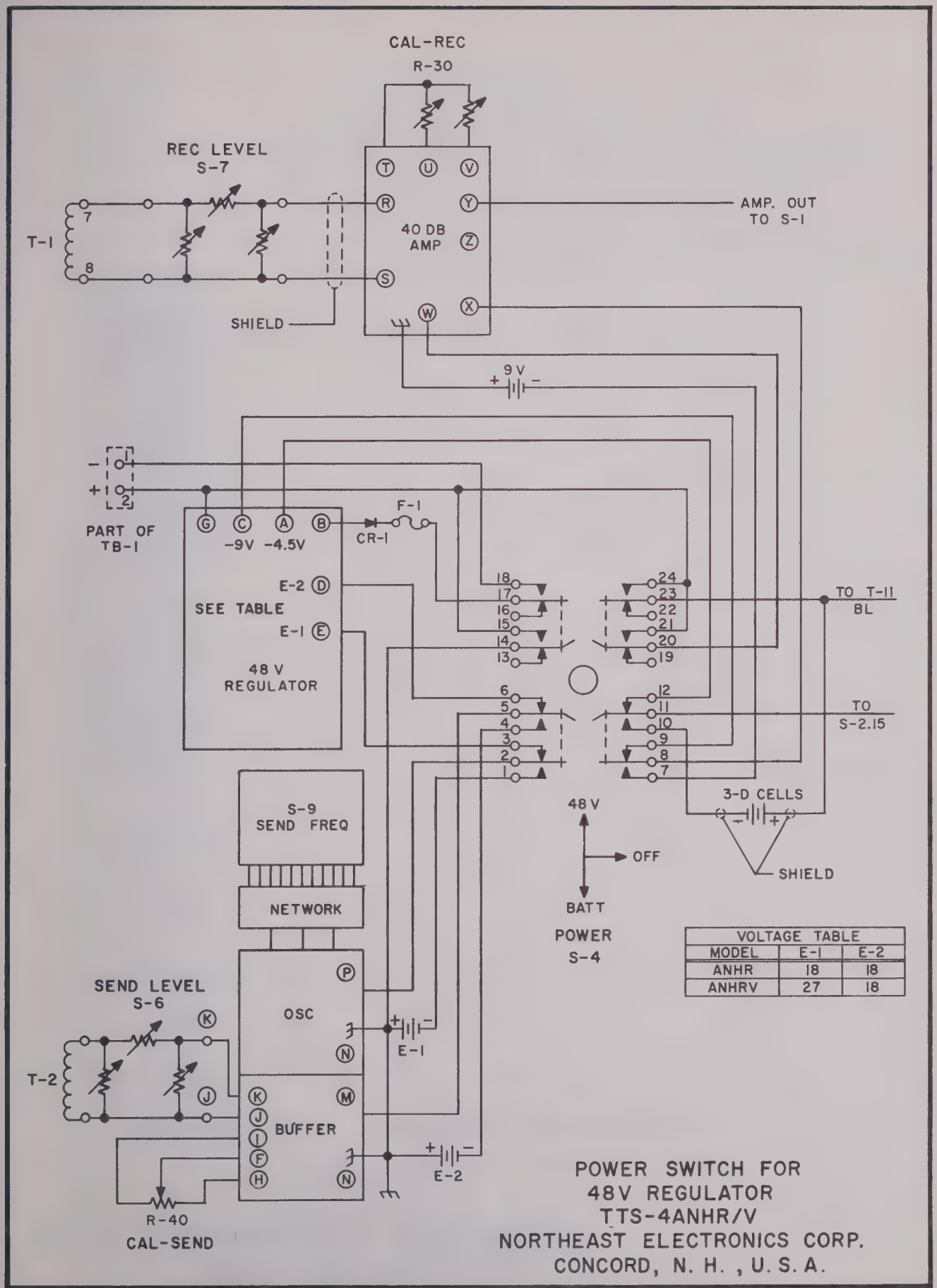

| VOLTAGE TABLE | | |
|---|---|---|
| MODEL | E-1 | E-2 |
| AN | 18 | 9 |
| ANH | 18 | 18 |
| XV/XDV | 27 | 9 |
| ANHXV/XDV | 27 | 18 |

POWER SWITCH FOR
48 V. REGULATOR

*MODEL TTS-4AN/ANH*

NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.

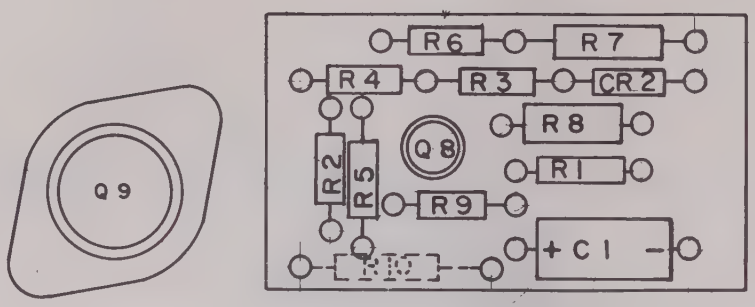
FIG. 8




| VOLTAGE TABLE | | |
|---|---|---|
| MODEL | E-1 | E-2 |
| ANHR | 18 | 18 |
| ANHRV | 27 | 18 |

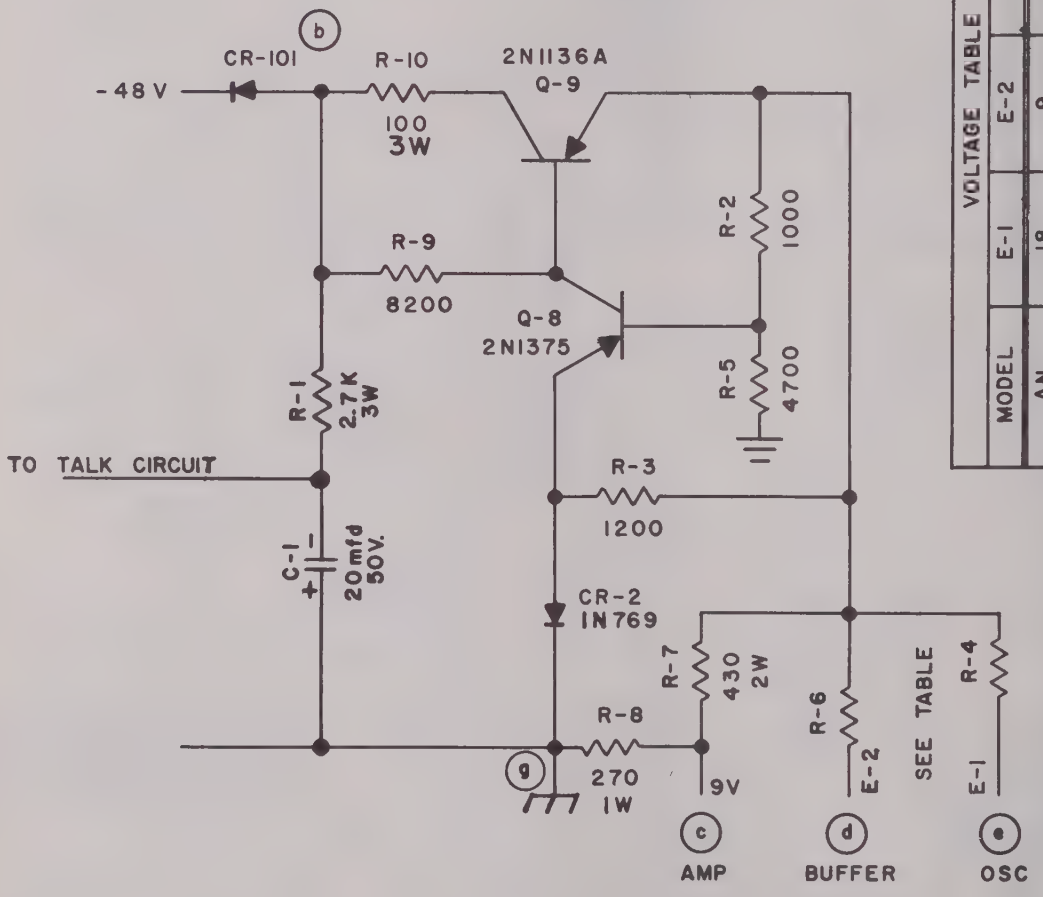
POWER SWITCH FOR
48V REGULATOR
TTS-4ANHR/V
NORTHEAST ELECTRONICS CORP.
CONCORD, N. H., U. S. A.

FIG. 9




## COMPONENT LOCATION

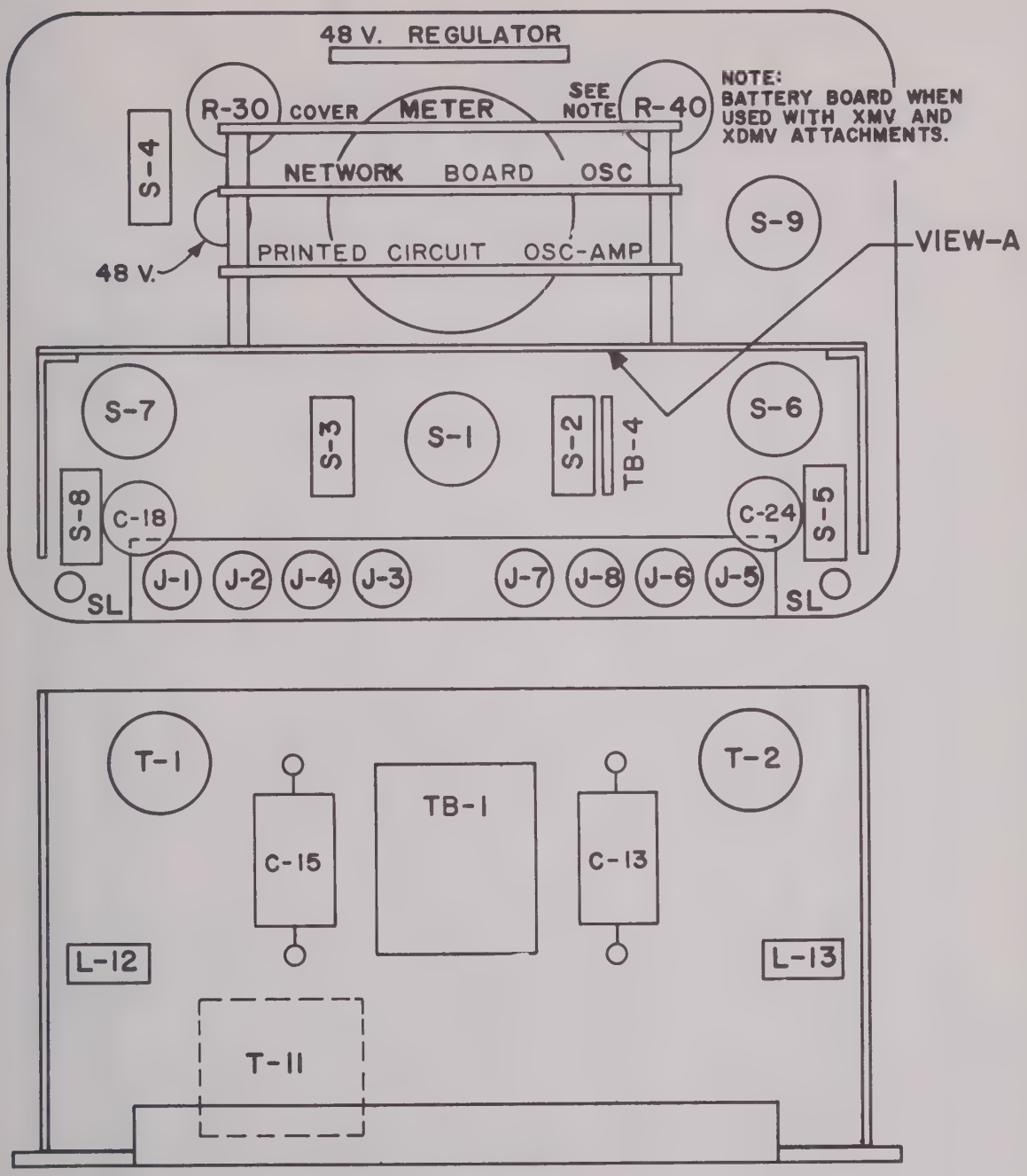
| VOLTAGE TABLE | | | | |
|---|---|---|---|---|
| MODEL | E-1 | E-2 | R-4 | R-6 |
| AN | 18 | 9 | 1000 | 3000 |
| ANH | 18 | 18 | 1000 | SELECTED |
| XV/XDV | 27 | 9 | 15Ω | 3000 |
| ANHXV/XDV | 27 | 18 | 15Ω | SELECTED |




## SCHEMATIC – MODEL TTS-4AN/ANH
## 48 Volt REGULATOR

NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

FIG.-10

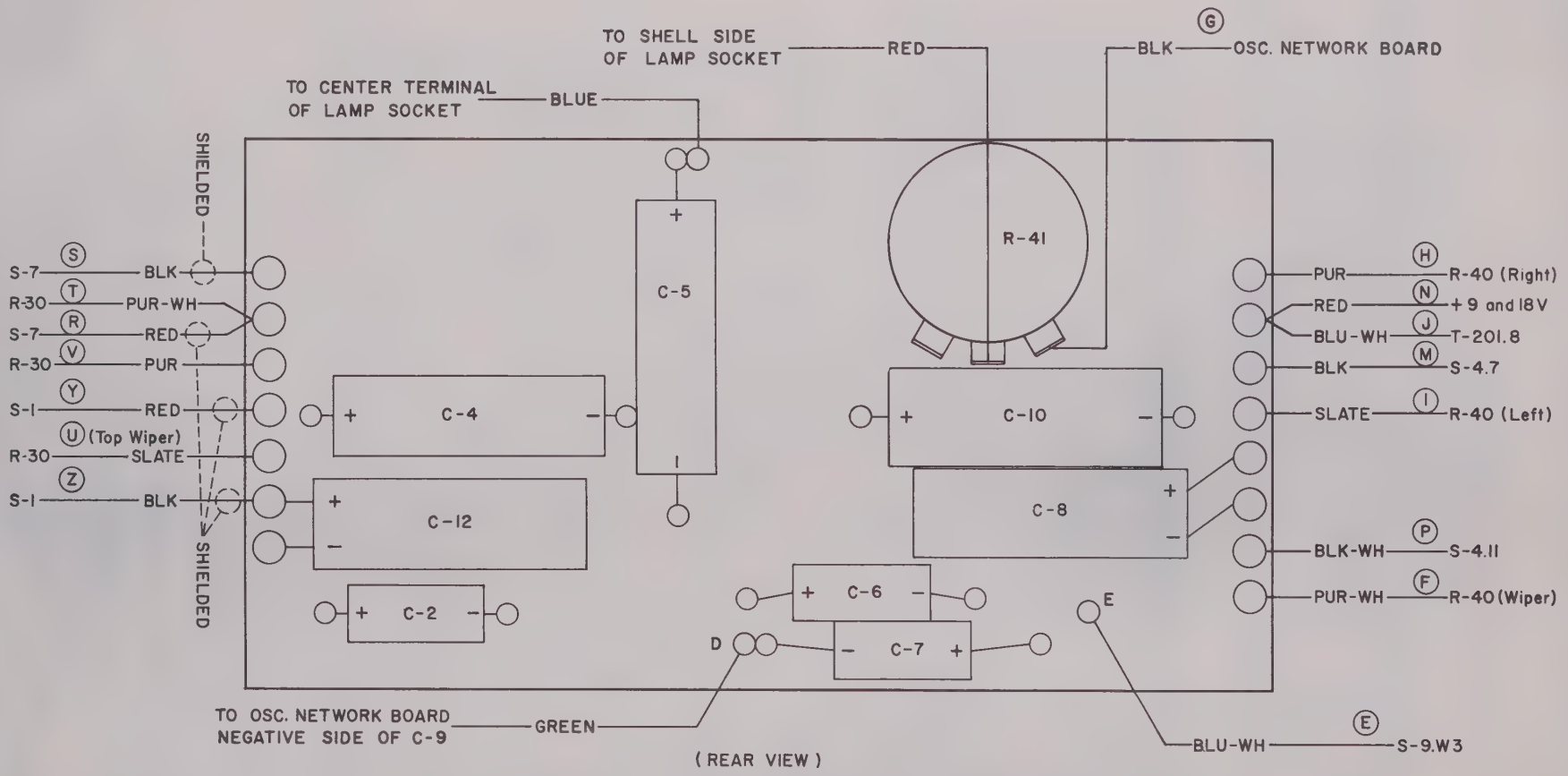



VIEW-A

NOTE: ALL VIEWS FROM WIRING SIDE.

GENERAL LAYOUT
MODEL TTS-4AN/ANH
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

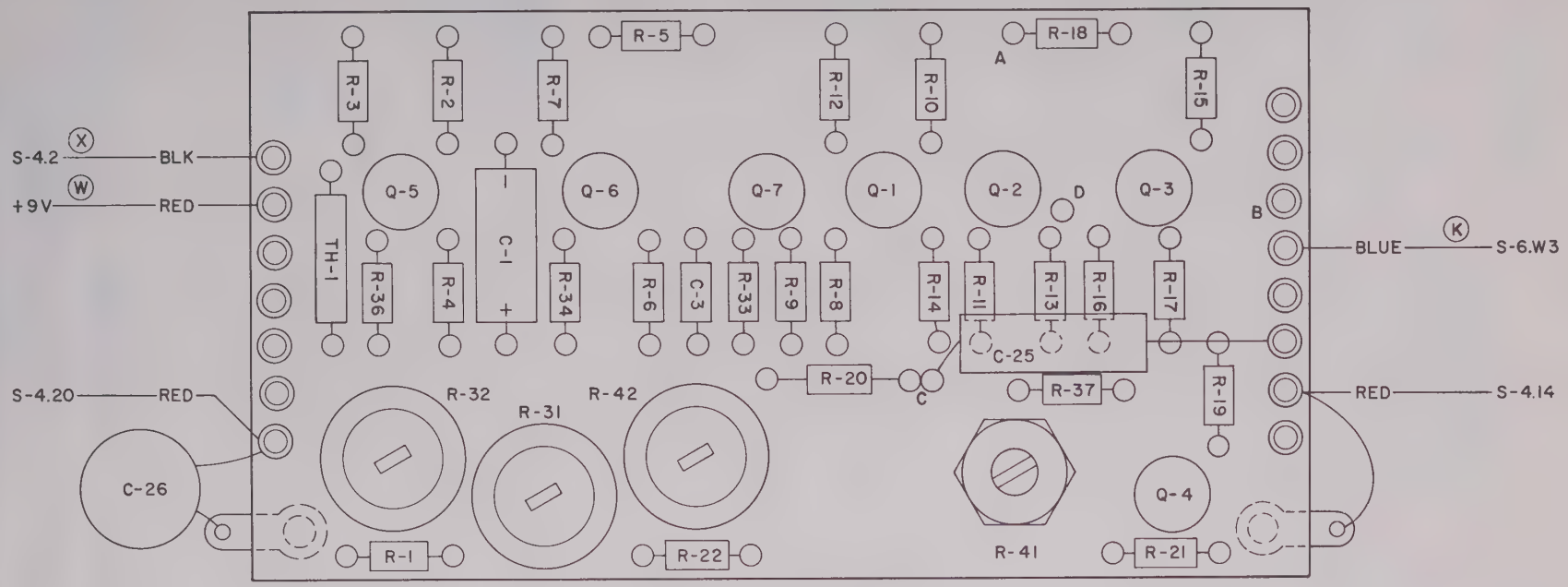
Fig-11




# GENERAL LAYOUT - PRINTED CIRCUIT BOARD
# MODEL TTS - 4AN/ANH

NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

FIG. 12



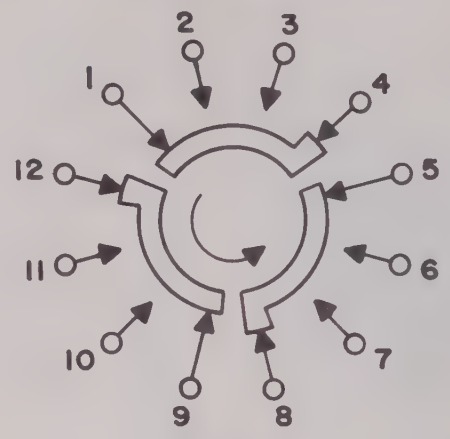

(TOP VIEW)

# GENERAL LAYOUT-PRINTED CIRCUIT BOARD
# MODEL TTS-4AN/ANH

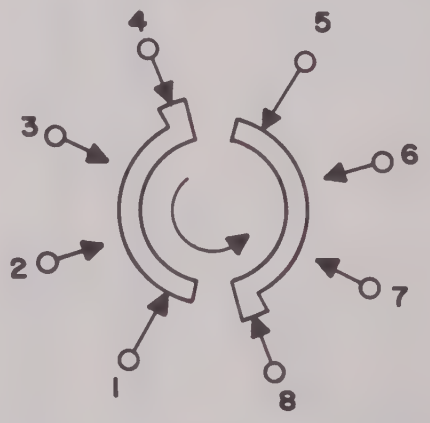
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

FIG. 13

SECTION- 1

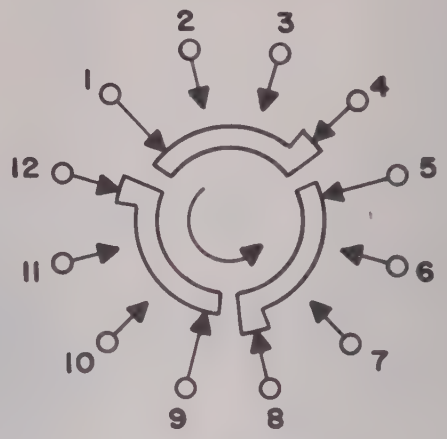



FRONT

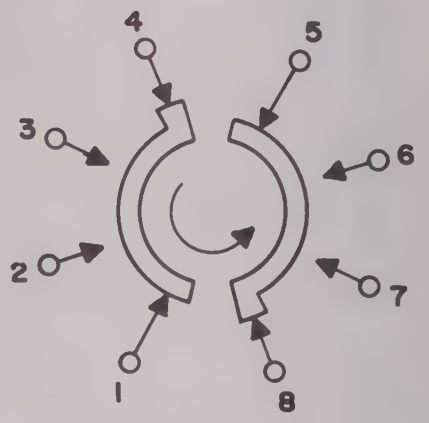



REAR

SECTION-2

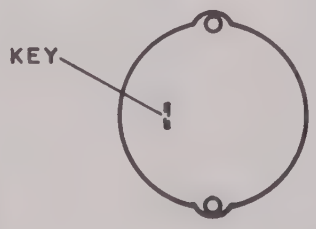


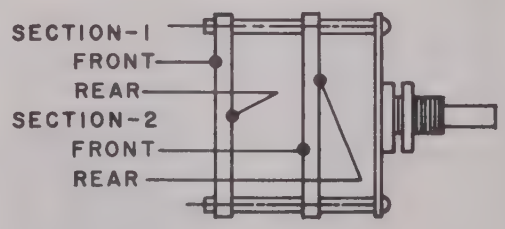

FRONT




REAR

NOTE: SWITCH VIEWED FROM WIRING SIDE, SHAFT IN EXTREME COUNTER CLOCK-WISE POSITION. TERMINAL NUMBERS FOR REFERENCE ONLY.



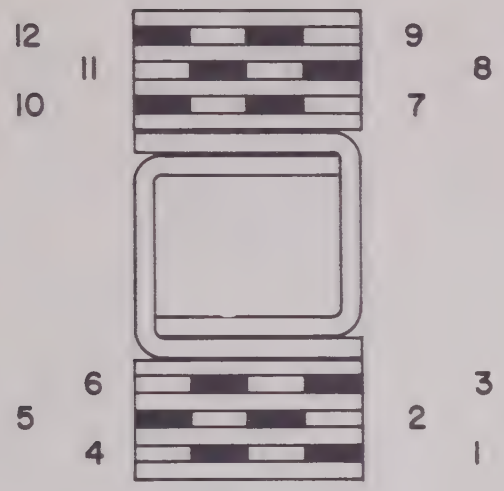




S-1 MODEL TTS-4AN/ANH

NORTHEAST ELECTRONICS CORP.

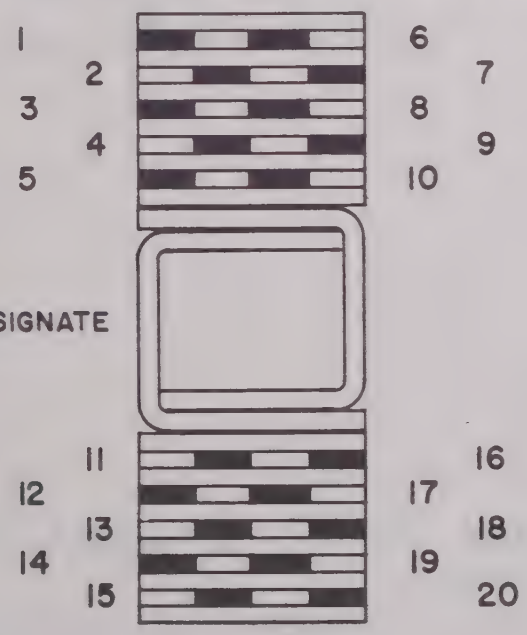
CONCORD, N.H.

Fig. 14




S-5

NOTE: SWITCH VIEWED FROM WIRING SIDE.
TERMINAL NUMBERS FOR REFERENCE ONLY.

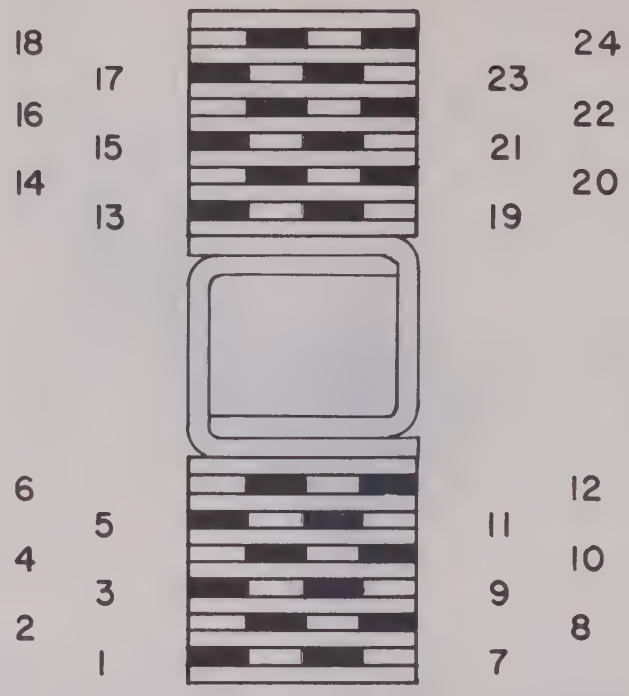



SHADED PORTIONS DESIGNATE SOLDER TERMINALS.

S-2 S-3

*MODEL TTS-4AN/ANH*
*NORTHEAST ELECTRONICS CORP.*
*CONCORD, N.H.*

*Fig 15*




S-4 S-8

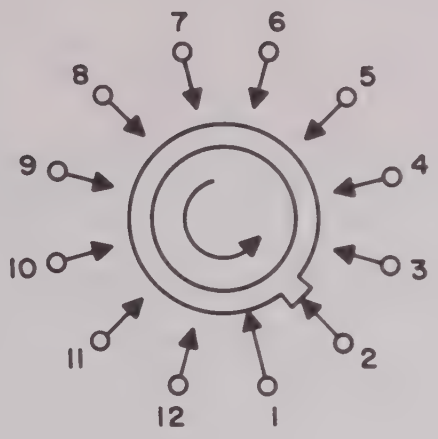
(TYPE 173 P)

NOTE: SHADED PORTIONS DESIGNATE SOLDER TERMINALS.
TERMINAL NUMBERS FOR REFERENCE ONLY.

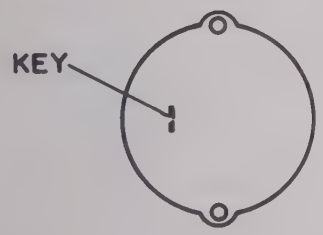
*MODEL TTS-4AN/ANH*

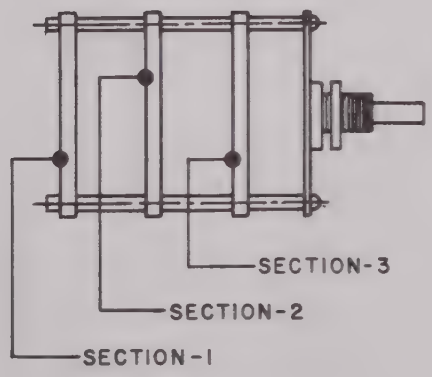
NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.

FIG-16



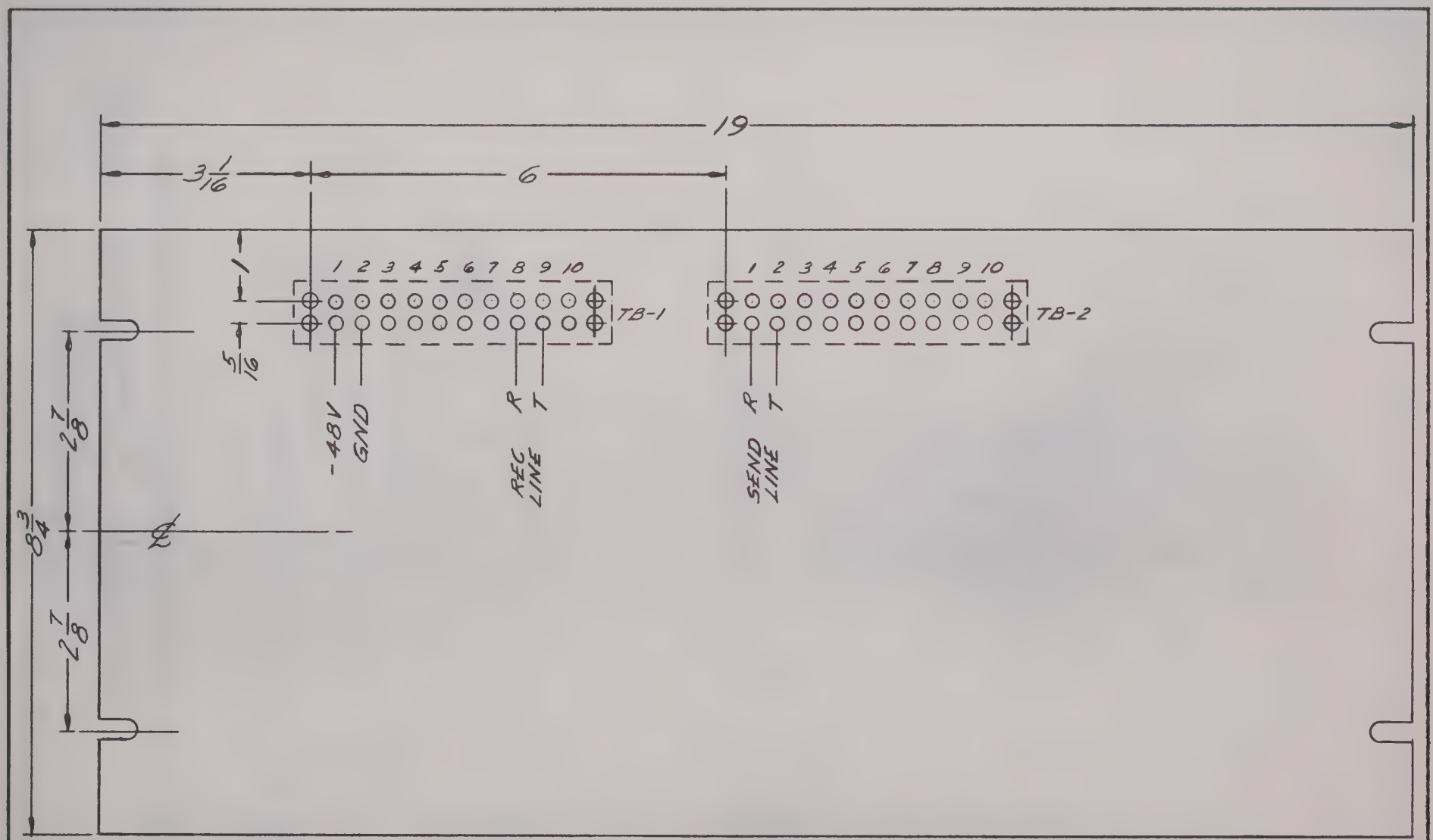

NOTE: SWITCH VIEWED FROM WIRING SIDE, SHAFT IN EXTREME COUNTER CLOCK-WISE POSITION.
TERMINAL NUMBERS FOR REFERENCE ONLY.




S-9 MODEL TTS-4AN/ANH
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

Fig. 17




REAR VIEW

FIG. 18

TTS-4ANHRV
INSTALLATION DIAGRAM

## TABLE OF REPLACEABLE PARTS

Page 1

| Circuit Ref | Description | MFR* & Mfr's Designation |
|---|---|---|
| C1 | Capacitor: fixed, electrolytic, 20 mfd, 20 vdc | J, APD-046 |
| C2 | Capacitor: fixed, electrolytic, 20 mfd, 20 vdc | J, APD-046 |
| C3 | Capacitor: fixed, paper, .005 mfd, 600 vdc | O, 6PS-D50 |
| C4 | Capacitor: fixed, electrolytic, 50 mfd, 20 vdc | J, APD-075 |
| C5 | Capacitor: fixed, electrolytic, 100 mfd, 20 vdc | J, APD-095 |
| C6 | Capacitor: fixed, electrolytic, 20 mfd, 20 vdc | J, APD-046 |
| C7 | Capacitor: fixed, electrolytic, 20 mfd, 20 vdc | J, APD-046 |
| C8 | Capacitor: fixed, electrolytic, 200 mfd, 20 bdc | J, A220-20ASRP-P |
| C9 | Capacitor: fixed, electrolytic, 20 mfd, 20 vdc | J, APD-046 |
| C10 | Capacitor: fixed, electrolytic, 100 mfd, 50 vdc | J, APD-127 |
| C12 | Capacitor: fixed, electrolytic, 200 mfd, 20 vdc | J, A220-20ASRP-P |
| C13 | Capacitor: fixed, paper, 4 mfd, 150 vdc | O, 121P40591R5S2 |
| C15 | Capacitor: fixed, paper, 2 mfd, 150 vdc | O, 121P20591R5S2 |
| C16 | Capacitor: fixed, paper, .0015 mfd, 600 vdc | O, 6TM-D15 |
| C17 | Capacitor: fixed, paper, .05 mfd, 110 vdc | O, 2TM-S5 |
| C18 | Capacitor: fixed, non-polarized, 50 mfd, 75 vdc | O, DFP50M75 |
| C19 | Capacitor: fixed, paper, .01 mfd, 100 vdc | O, 194P10351 |
| C20 | Capacitor: fixed, paper, .01 mfd, 100 vdc | O, 194P10351 |
| C22 | Capacitor: fixed, silver mica, 500 vdc ±5% | C, CM-20E Series Selected Values |
| C23 | Capacitor: fixed, silver mica, 500 vdc ±5% | C, CM-20E Series Selected Values |
| C24 | Capacitor: fixed, non-polarized, 50 mfd, 75 vdc | O, DFP50M75 |
| C25 | Capacitor: fixed, electrolytic, 100 mfd, 20 vdc | J, APD-095 |

## TABLE OF REPLACEABLE PARTS

Page 2

| Circuit Ref | Description | Mfr* & Mfr's Designation |
|---|---|---|
| C26 | Capacitor: fixed, paper, 2 mfd, 150 vdc | O, 121P20591R5S2 |
| C27 | Capacitor: fixed, disc, .01 mfd, 600 vdc | F, ID-01 |
| R | Lamp: tungsten ( used as resistor ), selected, 4 w, 120 vdc | I, T4-1/2 |
| R1 | Resistor: fixed, composition, 1 K ±5%, 1/2w | A, EB1025 |
| R2 | Resistor: fixed, composition, 150 K ±5%, 1/2w | A, EB1545 |
| R3 | Resistor: fixed, composition, 3.09 K±5%, 1/2w | A, EB3925 |
| R4 | Resistor: fixed, composition, 22 ohms ±5%, 1/2w | A, EB2205 |
| R5 | Resistor: fixed, composition, 180 K ±5%, 1/2w | A, EB1845 |
| R6 | Resistor: fixed, composition, 20 ohms ±5%, 1/2w | A, EB2005 |
| R7 | Resistor: fixed, composition, 1.8 K±5%, 1/2w | A, EB1825 |
| R8 | Resistor: fixed, composition, 33 ohms ±5%, 1/2w | A, EB3305 |
| R9 | Resistor: fixed, composition, 3 K ±5%, 1/2w | A, EB3025 |
| R10 | Resistor: fixed, composition, 82K ±5%, 1/2w | A, EB8235 |
| R11 | Resistor: fixed, composition, 10 K ±5%, 1/2w | A, EB1035 |
| R12 | Resistor: fixed, composition, 3 K ±5%, 1/2w | A, EB3025 |
| R13 | Resistor: fixed, composition, 1.5 K ±5%, 1/2w | A, EB1525 |
| R14 | Resistor: fixed, composition, 200 ohms ±5%, 1/2w | A, EB2015 |
| R15 | Resistor: fixed, composition, 100 K ±5%, 1/2w | A, EB1045 |
| R16 | Resistor: fixed, composition, 100 K ±5%, 1/2w | A, EB1045 |
| R17 | Resistor: fixed, composition, 10 K ±5%, 1/2w | A, EB1035 |
| R18 | Resistor: fixed, composition, 1.5 K ±5%, 1/2w | A, EB1525 |
| R19 | Resistor: fixed, composition, 16 K ±5%, 1/2w | A, EB1635 |

## TABLE OF REPLACEABLE PARTS

Page 3

| Circuit Ref | Description | Mfr* & Mfr's Designation |
|---|---|---|
| R20 | Resistor: fixed, composition, 680 ohms ±5%, 1/2w | A, EB6815 |
| R21 | Resistor: fixed, composition, 200 ohms ±5%, 1/2w | A, EB2015 |
| R22 | Resistor: fixed, composition, 3.9 K ±5%, 1/2w | A, EB3925 |
| R23 | Resistor: fixed, composition, 33 ohms ±5%, 1/2w | A, EB3305 |
| R24 | Resistor: fixed, composition, 18 ohms ±5%, 1/2w | A, EB1805 |
| R25 | Resistor: fixed, composition, 12 K ±5%, 1/2w | A, EB1235 |
| R26 | Resistor: fixed, composition, 1 K ±5%, 1/2w | A, EB1025 |
| R27 | Resistor: fixed, composition, 20 K ±5%, 1/2w | A, EB2035 |
| R28 | Resistor: fixed, composition, 2.7 K ±5%, 1/2w | A, EB2725 |
| R29 | Resistor: fixed, composition, 2.7 K ±5%, 1/2w | A, EB2725 |
| R30 | Resistor: variable, dual, wirewound, 500 ohms each section | G, CM25722 |
| R31 | Resistor: variable, wirewound, 500 ohms | L, 11106 |
| R32 | Resistor: variable, wirewound, 200 ohms | L, 11105 |
| R33 | Resistor: fixed, composition, 1 K ±5%, 1/2w | A, EB1025 |
| R34 | Resistor: fixed, composition, 3 K ±5%, 1/2w | A, EB3025 |
| R35 | Resistor: fixed, composition, 100 K ±5%, 1/2w | A, EB1045 |
| R36 | Resistor: fixed, composition, 2.2 K ±5%, 1/2w | A, EB2225 |
| R37 | Resistor: fixed, composition, 680 ohms ±5%, 1/2w | A, EB6815 |
| R40 | Resistor: variable, wirewound, 2.5 K | G, CM21616 |
| R41 | Resistor: variable, wirewound, 400 ohms | G, CM22425 |
| R42 | Resistor: variable, wirewound, 4 K | L, 11107 |

## TABLE OF REPLACEABLE PARTS



| Circuit Ref | Description | Mfr* & Mfr's Designation |
|---|---|---|
| R43 | Resistor: fixed, wirewound, 300 ohms ±1%, 1/4w | T, CR-16 |
| R44 | Resistor: fixed, wirewound, 300 ohms ±1%, 1/4w | T, CR-16 |
| R45 | Resistor: fixed, wirewound, 300 ohms ±1%, 1/4w | T, CR-16 |
| J1 | Jack: telephone | X, 245C or R, CMT5J-1191 |
| J2 | Jack: telephone | X, 245C or R, CMT5J-1191 |
| J3 | Jack: telephone | X, 239C or R, CMT5J-1192 |
| J4 | Jack: telephone | X, 248A or R, CMT5J-1193 |
| J5 | Jack: telephone | X, 239C or R, CMT5J-1192 |
| J6 | Jack: telephone | X, 248A or R, CMT5J-1193 |
| J7 | Jack: telephone | X, 223A or R, CMT5J-1194 |
| J8 | Jack: telephone | X, 223A or R, CMT5J-1194 |
| J9 | Jack: telephone | X, 239C or R, CMT5J-1192 |
| L12 | Inductor: series, 3.17 henry | NEC, TN1274 |
| L13 | Inductor: series, 3.17 henry | NEC, TN1274 |
| M | Meter: special | NEC, 1073-42258 |
| S1 | Switch: rotary, 3-position, 10-pole (FUNCTION) | F, A1073-M22-2 |

## TABLE OF REPLACEABLE PARTS

Page 5

| Circuit Ref | Description | Mfr* & Mfr's Designation |
|---|---|---|
| S2 | Switch: key, telephone, 3-position (MONITOR) | P, Type 173Y |
| S3 | Switch: key, telephone, 3-position (LINE) | P, Type 173Y |
| S4 | Switch: key, telephone, 2-position (POWER) | P, Type 173P |
| S5 | Switch: key, telephone, 3-position (SEND IMP) | P, Type 173N |
| S6 | Attenuator: Send | NEC, 1073-S6 |
| S7 | Attenuator: Receive | NEC, 1073-S7 |
| S8 | Switch: key, telephone, 3-position (REC IMP) | P, Type 173P |
| S9 | Switch: special, rotary, 11-position, 3-pole (OSC) | F, PA-024-3227 |
| T101 | Transformer: Receive: special | NEC, NES-918 |
| T201 | Transformer: Send, special | NEC, NES-918 |
| T11 | Inductor | X, 104A or equivalent |
| TH-1 | Thermistor | W, 43R1 |
| Q1-Q7 | Transistors | U, 2N1374 or equivalent |
| | Battery: 9-Volt (5 per set) | H, 226 |
| | Battery: D Cell (3 per set) 1.5 volts | H, 950 |
| | Knob: attenuator (2 per set) | K, S649-3L-BB |
| | Knob: for rotary switch S9 | K, S648-3L-BB |
| | Knob: for rotary switch S1 | M, 2250 |
| P1 | Panel Receptacle: for EXT FREQ | B, 165-36 |

## 48-VOLT REGULATOR
## TABLE OF REPLACEABLE PARTS

Page 6

| Circuit Ref | | Description | Mfr* & Mfr's Designation |
|---|---|---|---|
| R1 | Resistor: | fixed, wirewound, 2.7K ±5%, 3w | O, 242E-2725 |
| R2 | Resistor: | fixed, composition, 1 K ±10%, 1/2w | A, EB1021 |
| R3 | Resistor: | fixed, composition, 1.2 K ±10%, 1/2w | A, EB1221 |
| R4 | Resistor: | fixed, selected value | |
| R5 | Resistor: | fixed, composition, 4.7 K ±10%, 1/2w | A, EB4721 |
| R6 | Resistor: | fixed, selected value | |
| R7 | Resistor: | fixed, composition, 430 ohms ±5%, 2w | A, HB4315 |
| R8 | Resistor: | fixed, composition, 270 ohms ±10%, 1w | A, GB2711 |
| R9 | Resistor: | fixed, composition, 8.2 K ±10%, 1/2 w | A, EB8221 |
| R10 | Resistor: | fixed, wirewound, 100 ohms ±5%, 3w | O, 242E-1015 |
| C1 | Capacitor: | fixed, electrolytic, 20 mfd, 50 vdc | O, TE1305 |
| CR1 | Diode: | silicon | S1N2069 |
| CR2 | Diode: | regulator, silicon | V, 1N769 or equivalent |
| Q8 | Transistor | | U, 2N1375 |
| Q9 | Power Transistor | | E, 2N1136A |
| S4 | Power Switch: | key | P, 173P |
| J10 | Jack | | R, 53B |

*See "List of Manufacturers" Code Letters for Replaceable Parts Table

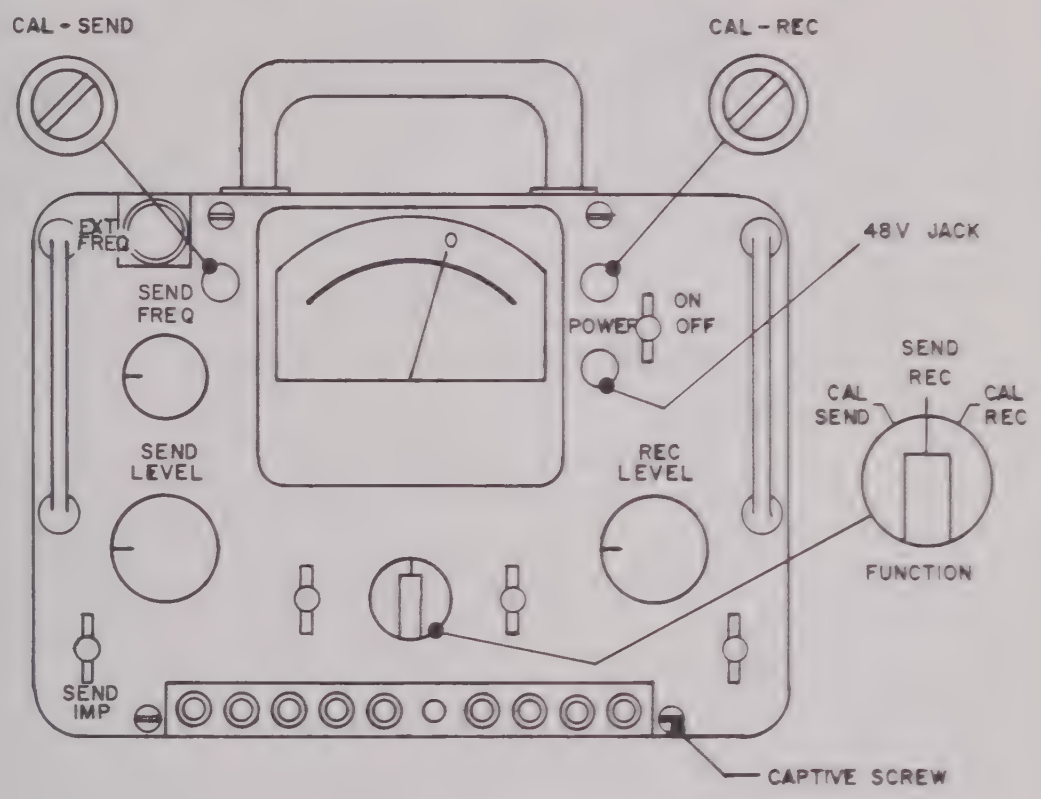
## LIST OF MANUFACTURERS CODE LETTERS FOR REPLACEABLE PARTS TABLE

| Code Letter | Manufacturer |
|---|---|
| A | Allen-Bradley Company |
| B | Amphenol Electronics Corporation |
| C | Arco Electronics, Inc. |
| D | Automatic Electric Company |
| E | Bendix Aviation Corporation |
| F | Centralab |
| G | Clarostat Manufacturing Company, Inc. |
| H | Eveready |
| I | Herzog Miniature Lamp Works, Inc. |
| J | International Electronic Industries, Inc. |
| K | Kurz-Kasch, Inc. |
| L | The Muter Company |
| M | H. H. Smith Company |
| NEC | Northeast Electronics Corporation |
| O | Sprague Electric Company |
| P | Stromberg-Carlson Company |
| R | Switchcraft, Inc. |
| S | Sylvania Electric Products, Inc. |
| T | Tel-Labs, Inc. |
| U | Texas Instruments, Inc. |
| V | Transitron Electronic Company |
| W | Victory Engineering Corporation |
| X | Western Electric Company, Inc. |

# MODEL 4AN TRANSMISSION TEST SET

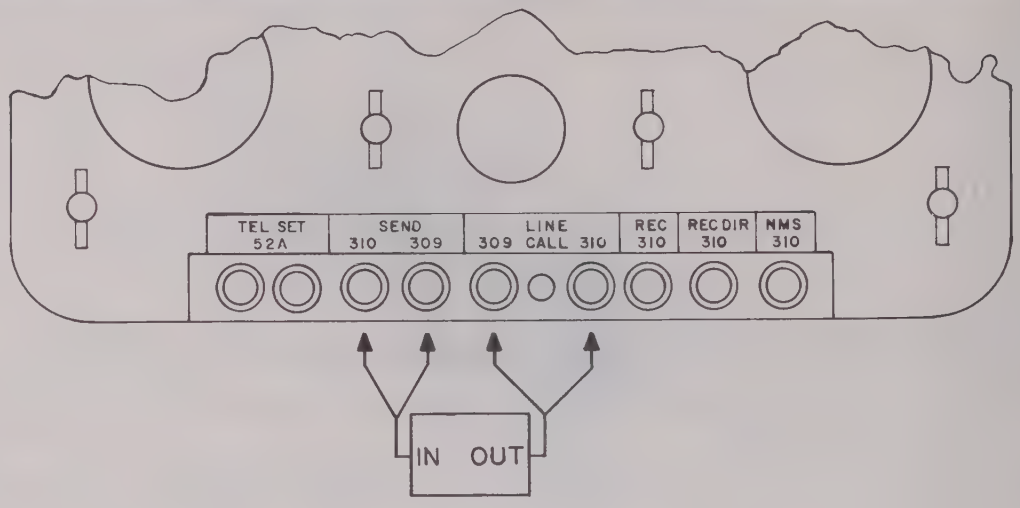
# OPERATION – GENERAL

## (A) PREPARATION




| STEP | PROCEDURE |
|---|---|
| 1 | Open lid. ( May be removed by moving cover to the right. ) |
| 2 | Turn POWER switch ON. |
| 3 | Wait 90 seconds for warm up. |
| 4 | Set SEND LEVEL and REC LEVEL to 0 ( CAL ). |
| 5 | Set FUNCTION to CAL SEND. |
| 6 | Set the SEND IMP to 600 P. |
| 7 | Adjust CAL SEND for 0 dbm on meter. |
| 8 | Set FUNCTION to CAL REC. |
| 9 | Adjust CAL REC for 0 dbm on meter. |
| 10 | Set FUNCTION to SEND REC. |

# (C) TO MAKE GAIN OR LOSS MEASUREMENTS




| STEP | PROCEDURE |
|---|---|
| 1 | Complete all steps under (A) PREPARATION. |
| 2 | Set SEND FREQ, SEND LEVEL and SEND IMP switches as required. |
| 3 | Connect input of equipment to be measured to SEND 310 or SEND 309. |
| 4 | Connect output of equipment to be measured to LINE 310 or LINE 309. |
| 5 | Operate LINE key to REC. |
| 6 | Turn REC LEVEL switch to obtain convenient reading on meter. |
| 7 | Gain or loss is the difference between sending level and receiving level. |

Example:

| SEND LEVEL | REC LEVEL | METER READING | GAIN (+) or LOSS (-) |
|---|---|---|---|
| 0 | - 5 | -1.2 | - 6.2 |
| 0 | +7 | - .3 | +6.7 |
| -20 | +12 | -2.0 | +30.0 |

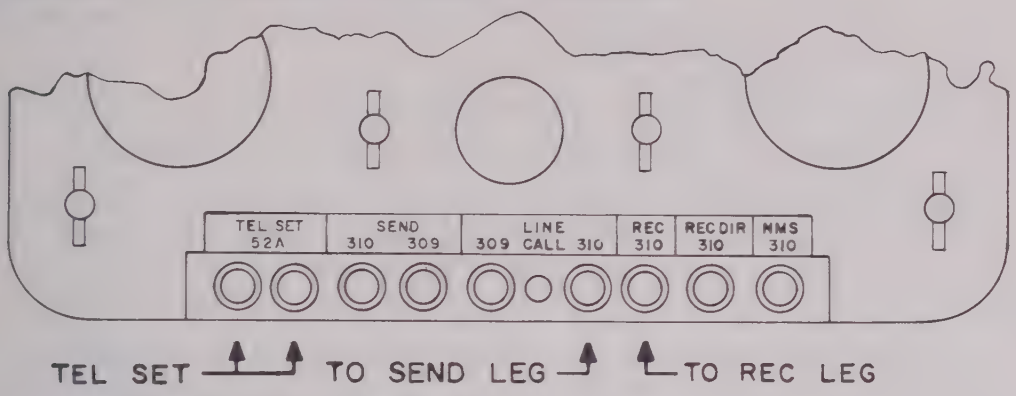
# (D) TO OPERATE SET FROM 48-V STATION BATT.

| STEP | PROCEDURE |
|---|---|
| 1 | Open lid. ( May be removed by moving cover to the right ). |
| 2 | Insert cord in jack marked 48-V in transmission test set. |
| 3 | Insert jack in 48 volt appearance. |
| | **CAUTION:** Do not reverse step 2 and 3 |
| | The set is now ready for use. |
| 4 | Turn POWER switch to 48V. Position. |
| 5 | Wait 90 seconds for warm up. |
| 6 | Set SEND LEVEL and REC LEVEL to 0 ( CAL ). |
| 7 | Set FUNCTION to CAL SEND. |
| 8 | Adjust CAL SEND for 0 dbm on meter. |
| 9 | Set FUNCTION to CAL REC. |
| 10 | Adjust CAL REC for 0 dbm on meter. |
| 11 | Set FUNCTION to SEND REC. |
| 12 | To disconnect test set from station battery, first turn power switch to OFF, next remove cord from 48 volt station appearance, finally remove cord from transmission test set. |
| | **CAUTION:** Do not change the sequence of steps described here. |

# (E) TO USE HOLDING FEATURES OF TTS-4AN IN CONNECTION WITH NOISE MEAS. EQUIP.

| STEP | PROCEDURE |
|---|---|
| 1 | Connect the noise measuring set to a cord terminated in a type 310 plug. |
| 2 | Insert the cord from the noise measuring set in the jack marked NMS.<br><br>**NOTE:** This disconnects the RECEIVE circuit of the transmission measuring set. |
| 3 | At the completion of the noise measuring test, remove the cord from the NMS jack.<br><br>**NOTE:** This restores the RECEIVE section of the transmission measuring set to its normal operation. |

# (F) TESTING 4-WIRE CIRCUITS




## F. 1 4-WIRE CIRCUITS IN GENERAL

| STEP | PROCEDURE |
|---|---|
| 1 | Complete all steps under ( A ) Preparation. |
| 2 | Set SEND and RECEIVE impedance switches to the desired value. |
| 3 | Connect headset cord to TEL SET jack. |
| 4 | Set LINE/MON switch to MON AND 4W TALK position. |
| 5 | SET LINE switch to TALK position. |
| 6 | Insert a 4-wire cord into the LINE and REC jacks which are marked 4-W SND and 4-W REC. |
| 7 | Insert the other end of the 4-wire cord into the twin LINE jacks of the 4-wire telephone set. |

## F. 2 DIALING ON 4-WIRE CIRCUITS

**Multi-Frequency Dialing**

Some 4-wire systems are equipped with multi-frequency tone dailing generated in the subscriber set. If the TTS 4AN Unit is to be used in such a circuit and it is desired to establish connection, complete all the steps 1-7 listed above and thereafter proceed as follows:

| STEP | PROCEDURE |
|---|---|
| 8 | Insert a 2-wire cord into the EQUIP-SEND jack of the telephone set and remove its hand set. |
| 9 | Insert the other end of the 2-wire cord into the NMS jack of the TTS 4AN. |
| 10 | Move the LINE switch in the TTS 4AN set to the REC position. |
| 11 | Establish the desired connection by dialing the desired number in the 4-wire telephone set. |

12 Move the LINE switch to the TALK position and check that the desired number has been reached.

13 Return the hand set of the 4-wire telephone set to the ON HOOK condition.

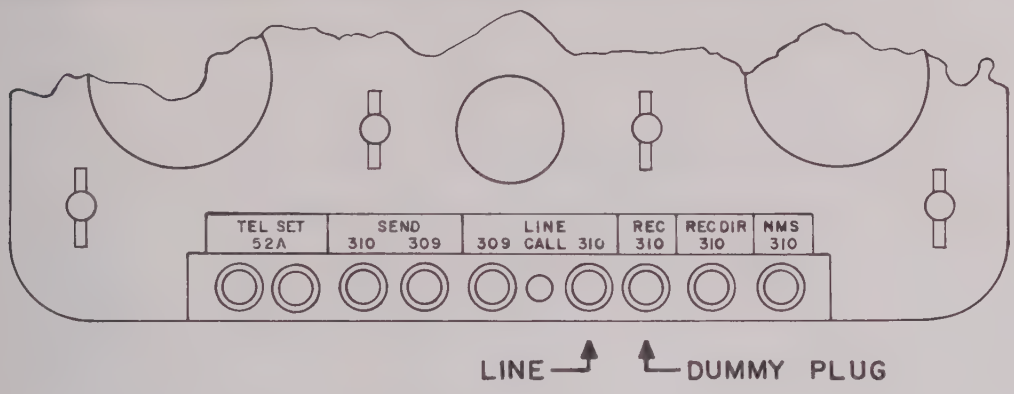
14 The TTS 4AN is now ready to make transmission measurements.

15 Upon completion of measurements; move the LINE switch to TALK and the LINE/MON switch to LINE OPEN. This releases the circuit.

## E&M DIALING

If it is desired to establish circuits by dialing in 4-wire circuits equipped with E&M supervision, the TTS 4ANX26C may be used. This unit is the standard TTS 26C Dial Pulse Test Set mounted in a cover which fits the TTS 4AN Units. The operation of the TTS 26C is described in its manual. Having established the connection with the aid of this test set steps 1-7 should be executed. Thereafter the TTS 4AN equipment is ready to make measurements on the 4-wire circuit.

# (G) TO USE PRECISION TERMINATION




| STEP | PROCEDURE |
|---|---|
| 1 | Select desired terminating impedance on REC IMP key. |
| 2 | Connect circuit to be terminated to LINE 310 jack. |
| 3 | Insert a "dummy" plug in the REC 310 jack. |
| 4 | Move the LINE key to the REC position. The circuit under test is now terminated in either 600 ohms +2 mfd or 900 ohms +2 mfd. |

Appendix 2

Page 1

# MODEL TTS 4XD DIAL ADAPTER COVER

# OPERATING INSTRUCTIONS

## 1.0 GENERAL

**1.01** The Model TTS 4XD is an attachment for the Models TTS 4AN and 4ANH Transmission Test Sets. It is inserted between the circuit under test and the LINE jack of the TTS 4AN. When a 52A headset is plugged into the TEL SET jacks of the TTS 4AN, the basic set with the TTS 4XD adapter provides complete dialing and talking functions in addition to the transmission measuring functions. The TTS 4XD provides for mounting a ringer for cases where audible signaling is to be substituted for the neon bulb call indicator in the TTS 4AN.

**1.02** This cover is also supplied in combination with other accessories as described in the instructions for these covers.

## 2.0 DESCRIPTION

**2.01** This cover contains a dial, hookswitch, jacks for connecting to the basic test set, a jack and binding posts for external line connections, mounting holes and space for a ringer, and storage space for a headset, cords, and small tools; a hinged lid with locking clamp covers the storage space. Fig. 1 shows the schematic diagram of the TTS 4XD.

**2.02** The TTS 4XD is housed in a cover measuring 8" x 11" x 4" and weighs 4 3/4 pounds.

## 3.0 OPERATION

**3.01** The line to be used for testing and talking is connected to the binding posts or jack marked LINE.

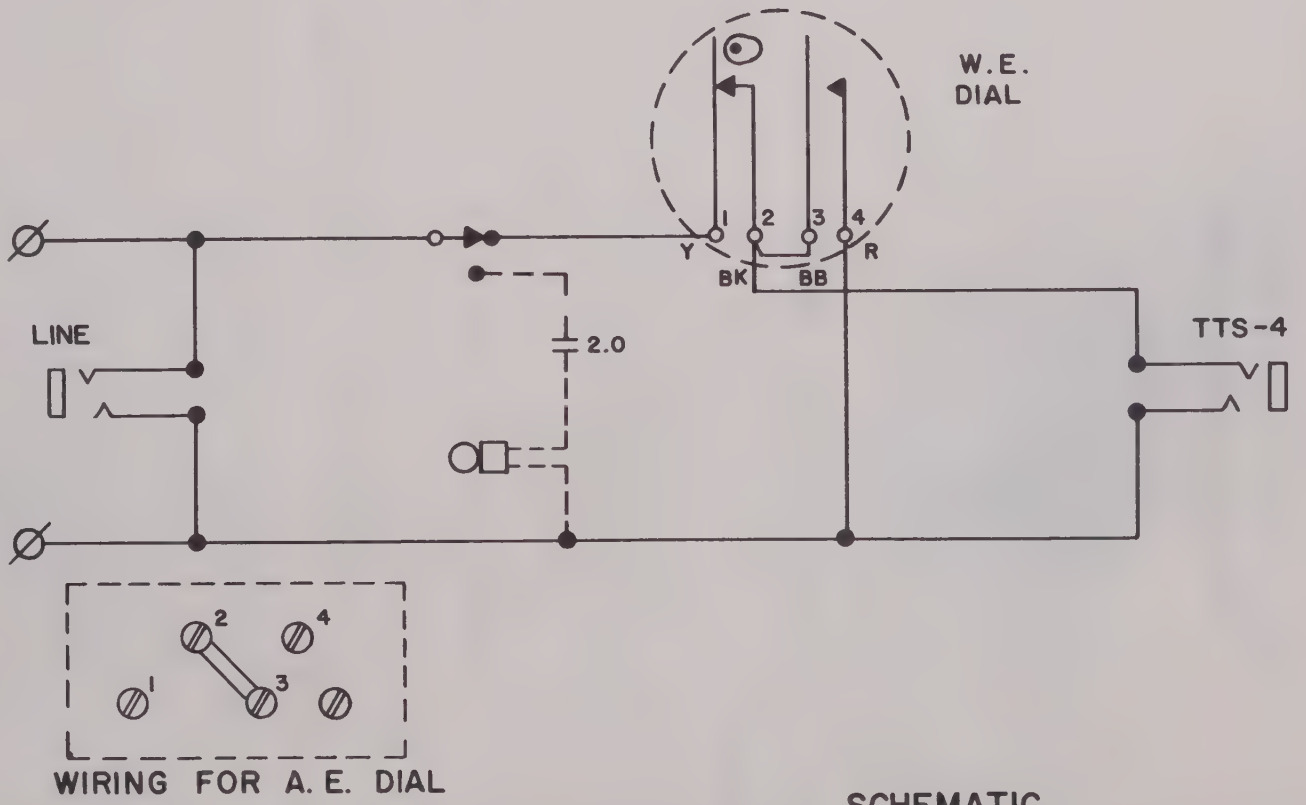
**3.02** A connecting cord is then plugged into the jack marked TTS 4 and the other end is plugged into the jack on the TTS 4AN marked LINE.

**3.03** If no ringer is installed in the TTS 4XD, the toggle switch marked LINE should be in the ON position. The DC conditions (on or off hook) are then under the control of the LINE switch and incoming ringing will operate the neon bulb in the TTS 4AN. The LINE key in the TTS 4AN should be placed in the HOLD position. The toggle switch in the TTS 4XD is then used to control the DC line conditions (on or off hook).

**3.04** A type 52A headset should be plugged into the TEL SET jack on the TTS 4AN and the equipment is now ready for dialing out and receiving calls.

## 4.0 MAINTENANCE

**4.01** The Model TTS 4XD does not require any routine maintenance.




SCHEMATIC
TTS-4-XD

NORTHEAST ELECTRONICS CORPORATION
CONCORD, N.H.

# MODELS TTS 4XBA AND 4XDBA PREAMPLIFIER COVERS

# OPERATING INSTRUCTIONS

## 1.0 GENERAL

**1.01** The Model TTS 4XBA is an attachment for the Models TTS 4AN and 4ANH Transmission Test Sets. It performs the following functions:

1. Provides high impedance bridging measurements at full sensitivity for the TTS 4AN transmission test equipment.
2. Provides a 1 db per step 5 db switchable attenuator, thus permitting a 0 db meter reading at points intermediate to the 5 db attenuator positions of the basic test sets.
3. Provides a switchable high pass filter to eliminate the 60 cps power frequency and its lower order harmonics from the transmission measurements.
4. Provides a switchable input terminating resistor to permit gain calibration of the adapter with the calibration circuits provided in the basic test sets.

**1.02** Because its meters have the proper ballistic characteristics, the TTS 4AN test sets can be used for terminated VU measurements at full sensitivity and for bridging VU measurements at reduced sensitivity. Together with the TTX 4XBA adapter, these sets can be used for bridging VU measurements at full sensitivity.

## 2.0 DESCRIPTION

**2.01** The TTS 4XBA cover contains a fixed gain, transistorized amplifier, a switchable high pass filter, an input impedance switch, a 5-position, 1 db step attenuator, LINE jack and binding posts, a jack for a patch cord between the TTS 4XBA and the TTS 4AN, and two 9-volt batteries connected in series for operating the amplifier. A schematic diagram of the TTS 4XBA is shown in Fig. 1. The gain in the amplifier is close to unity as emitter follower stages are used.

**2.02** One half of the cover contains the circuitry described above; the other half is a storage compartment for small tools, cords, etc., which has a hinged door with a locking clamp. The circuitry of the Model TTS 4XD cover can be mounted on the hinged cover with a reduction in storage facilities. This model is designated the TTS 4XDBA.

**2.03** The TTS 4XBA is housed in a cover measuring 8" x 11" x 4" and weighs approximately 4 pounds.

## 3.0 PERFORMANCE

**3.01** The input impedance can be switched to either 600 ohms or a bridging impedance of 12,000 ohms.

**3.02** Frequency Response. Variations from 1000 cps response:

a. Filter OUT
Flat with 0.2 db between 20 cps and 20 kc

b. Filter IN

| | |
|---|---|
| 60 cps greater than | -25 db |
| 200 cps approximately | -6 db |
| 300 cps approximately | -2 db |

In general the response of the TTS 4XBA with the filter in the circuit is approximately the same as that of a Type 500 telephone set.

**3.03** Battery life is approximately 90 hours when used on an intermittent basis.

## 4.0 OPERATION

**4.01** Battery power is supplied to the amplifier only when a plug is inserted in the TTS 4AN (PWR ON) jack. One end of a patch cord should be inserted in this jack and the other end in the REC jack of the TTS 4AN.

**CAUTION:** Do not leave the cord in the TTS 4AN (PWR ON) jack when the equipment is not being used, as the battery life is substantially reduced by continuous operation.

**4.02** Set the switches to the desired operating position, i.e., 600 ohm or bridging, filter IN or filter OUT, and the attenuator to 0 db.

**4.03** Operate the TTS 4AN set in the normal manner. If a 0 db reading is desired at levels intermediate to the 5 db steps in the TTS 4AN, move the attenuator switch in the TTS 4XBA to the desired position.

## 5.0 CALIBRATION

**5.01** If the REC section of the TTS 4AN is not calibrated through the TTS 4XBA, there will be a maximum possible error of 0.3 db in the absolute value of measurements. For some applications, such as VU measurements, this is not significant. For other measurements where greater accuracy is desired, the following calibration procedure should be used:

a. Connect the SEND jack on the TTS 4AN to the LINE jack or binding posts on the TTS 4XBA.

b. Set the IMP switch on the cover to 600 and the LEVEL switch to 0 db. The filter switch should be in the position in which it is to be used.

c. Set the SEND IMP switch on the basic set to the 600 ohm position, the SEND LEVEL switch to 0 ( CAL ), and set the SEND FREQ switch to 1000.

d. Set the REC IMP switch to the 600 ohm position on the basic set and the REC LEVEL switch to 0 ( CAL ).

e. Calibrate the send level in the TTS 4AN in the normal manner by turning FUNCTION switch to CAL SEND.

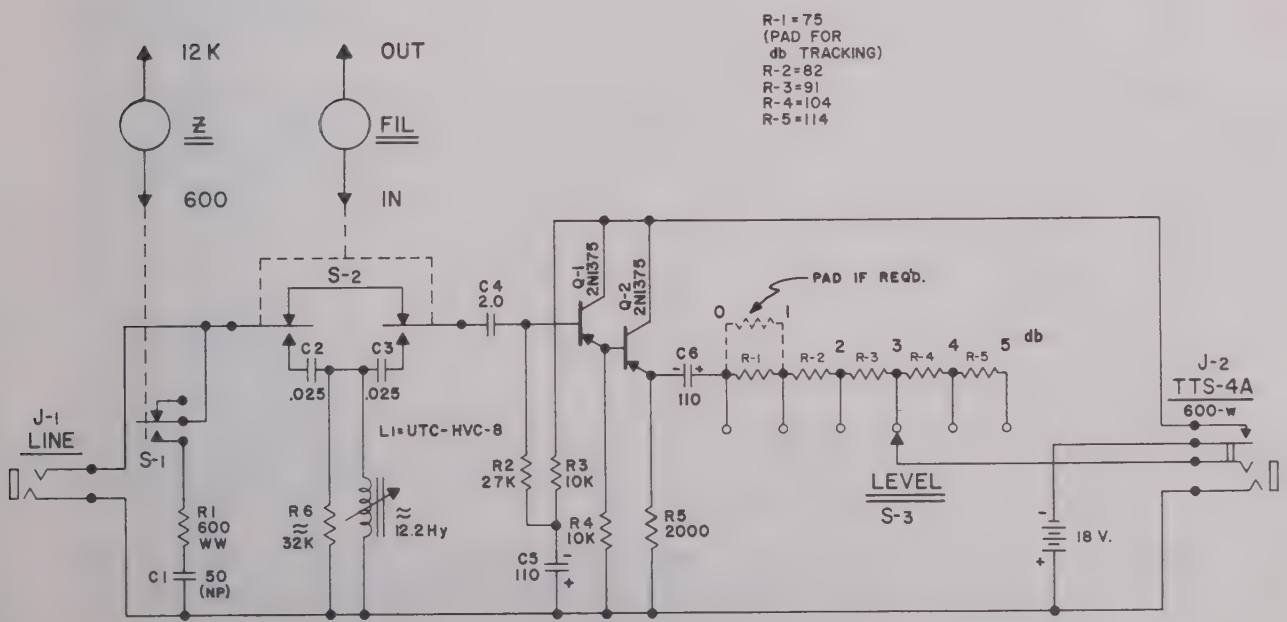
f. Turn the FUNCTION switch to the SEND-REC position and adjust the CAL REC control to give a 0 db reading on the meter. Remove the cord between the SEND jacks on the TTS 4AN and the LINE jack on the TTS 4XBA.

g. The IMP switch on the cover may now be set to BRDG or 600 as desired.

h. Connect the circuit to be tested to the LINE jack or the binding posts of the TTS 4XBA.

## 6.0 MAINTENANCE

**6.01** The amplifier uses two Burgess P6 9-volt batteries connected in series. Satisfactory performance is obtained until the total voltage has reached 9 volts under load. The batteries should be checked periodically and changed when this voltage level is reached.



# MODELS TTS 4XV AND TTS 4XDV VARIABLE FREQUENCY COVERS

## OPERATING INSTRUCTIONS

### 1.0 GENERAL

**1.01** The Models TTS 4XV and TTS 4XDV attachments contain an external frequency determining network for the Models TTS 4AN and 4ANH Transmission Test Sets. They provide a continuously variable frequency coverage from 20 cps to 20,000 cps.

**1.02** The TTS 4AN with which the TTS 4XV or 4XDV is to be used must be modified and equipped with mounting provisions to accommodate extra batteries which are required for the oscillator section. Furthermore, to provide the specified accuracies in level stability and frequency, the TTS 4XV or 4XDV should be calibrated with the basic set to which it will be attached.

**1.03** The TTS 4XV and 4XDV are housed in a cover measuring 11" x 8" x 5 3/4" and weigh approximately 6 pounds. The TTS 4XDV has the functions and circuits of the TTS 4XD in addition to the variable frequency network functions. For a description of these additional functions see the instructions for the TTS 4XD.

### 2.0 TRANSMISSION PERFORMANCE

**2.01** The frequency range of 20 cps to 20,000 cps is covered in six ranges selected by a range selector switch. A continuously variable adjustment controls the frequency within each range.

**2.02** The output level of the oscillator is constant within ±0.20 db and the frequency accuracy is ±2% when the TTS 4XV or 4XDV is used with the basic unit with which it has been calibrated. Typical units have shown level stabilities of ±0.10 db.

**2.03** The circuit diagram of the variable frequency network is shown in Fig. 1.

### 3.0 OPERATION

**3.01** Plug the connector at the end of the cable in the cover into the connector on the TTS 4AN marked EXT FREQ.

**3.02** Turn the SEND FREQ switch to EXT.

**3.03** In the TTS 4XV or 4XDV cover set the RANGE switch to BX100 and set the continuous tuning control to 60 on scale B.

**3.04** Perform the CAL SEND and CAL REC operations on the basic set in the normal manner and return the FUNCTION switch to the SEND-REC position.

**CAUTION:** The setting of the CAL SEND control to obtain a 0 dbm output differs (by about 2 db) for the internal fixed frequencies and the frequencies provided by the TTS 4XV and 4XDV. When transferring from one operation to the other the CAL SEND setting must be recalibrated.

**3.05** For operation above 200 cps use the TTS 4AN test set in the normal manner and select the operating frequency by setting the controls on the cover to the desired value. Specifically, the associated basic test set may be used for either a 600 ohm or 900 ohm send impedance as desired.

**3.06** For operation over the full frequency range move the SEND IMP switch on the TTS 4AN to the 600P position. This switch position provides an output impedance of 600 ohms, removes the hold coil from the SEND circuit, and increases the capacity of the blocking condenser which is inserted in the center of the split and balanced send transformer.

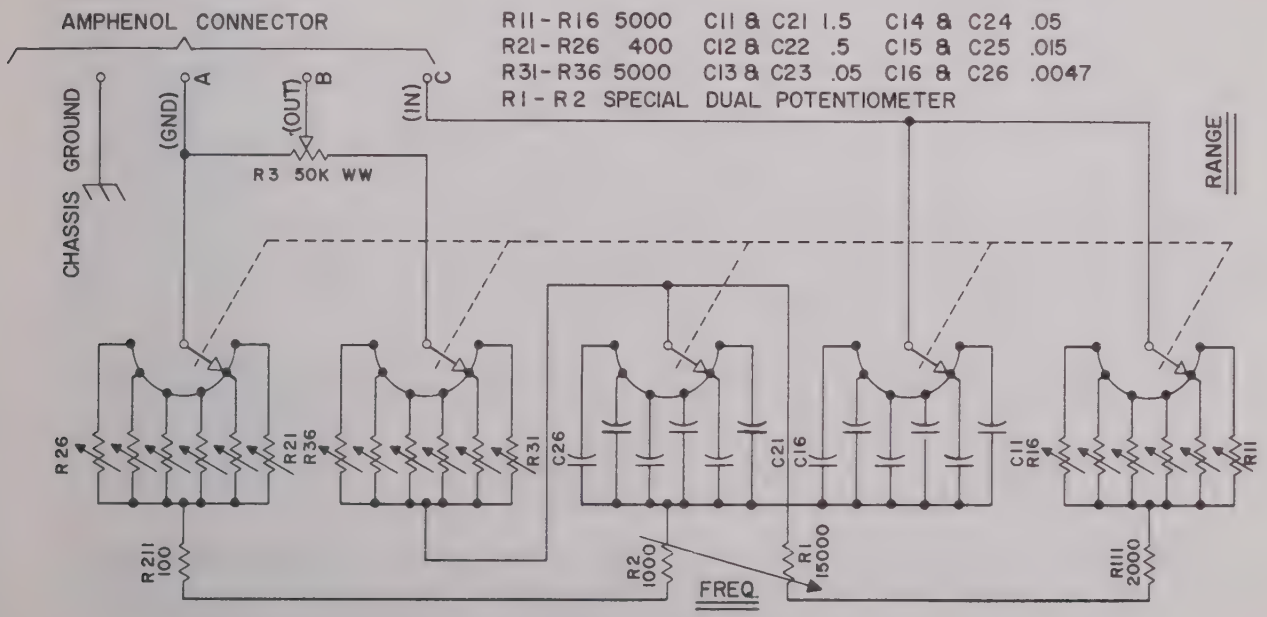
**CAUTION:** Use only the 600P position of the SEND IMP switch below 200 cps.

## 4.0 MAINTENANCE

**4.01** The TTS 4XV and 4XDV do not require routine maintenance.

**4.02** In view of the critical adjustments which must be made to calibrate the set when any components are replaced, it is recommended that the TTS 4XV or 4XDV be returned to the factory for repairs, together with the basic set with which it is to be used.

**4.03** For repairing units in the field a fully equipped maintenance shop must be available, and special adjustment procedures and test jigs should be obtained from the manufacturer.



# MODELS TTS 4XMF AND TTS 4XMP MULTI-FREQUENCY ADAPTER COVERS

## OPERATING INSTRUCTIONS

### 1.0 GENERAL

**1.01** The Models TTS 4XMF and TTS 4XMP are accessory covers for the Model TTS 4AN and 4ANH Transmission Test Sets. Each of these adapter units can be plugged into the EXT FREQ plug of the TTS 4AN series and thus be connected to the oscillator circuit of the basic test set. When the SEND FREQ switch on the basic set is turned to the EXT position, these adapters provide tuning elements for 27 test frequencies which supplement those already available on the basic set.

**1.02** Both models can be supplied in combination with the Model TTS 4XD cover; these are designated as the TTS 4XDMF and TTS 4XDMP. For a description of the additional functions see the instructions for the Model TTS 4XD.

### 2.0 PERFORMANCE

**2.01** Level Variation with frequency: ±0.2 db.

**2.02** Frequency accuracy: ±2%.

### 3.0 DESCRIPTION

**3.01** The Models TTS 4XMF and TTS 4XMP both have a 27 position selector switch to select the tuning elements required to provide 27 discrete frequencies for the oscillator in the TTS 4AN series of sets. These tuning elements are connected to the appropriate terminals in the oscillator through a cable and plug which fits into the connector on the panel marked EXT FREQ. The schematic diagram is shown in Fig. 1.

**3.02** The Model TTS 4XMF provides means for selecting 27 frequencies in 100 cps increments from 300 cps to 2,900 cps for measuring the response of FAA voice frequency control circuits. The 3,000 cps frequency also required for this test is provided by the basic test set.

**3.03** The Model TTS 4XMP provides means for selecting the 27 frequencies between 35 cps and 15KC which are normally required for testing program circuits.

**3.04** A storage space which is covered by a hinged lid with a locking clamp is available for storing a headset, cords and small tools.

**3.05** The size of these covers is 8" x 11" x 4", and they weigh 3 1/2 pounds. In combination with the Model TTS 4XD dial assembly the weight is 4 1/2 pounds.

## 4.0 OPERATION

The following instructions should be followed for the Models TTS 4XMF and TTS 4XMP covers.

**4.01** Calibrate the basic set in the normal fashion.

**4.02** Insert the plug at the end of the cable in the cover into the connector marked EXT FREQ on the panel of the basic set.

**4.03** Turn the SEND FREQ switch to EXT.

**4.04** Set the frequency selector switch on the cover to 1 KC.

**4.05** Turn the FUNCTION switch in the basic set to CAL-SEND and adjust the CAL SEND control on the basic set to obtain 0 dbm on the meter in accordance with the instructions previously supplied for setting the level in the basic set.

**4.06** Return the FUNCTION switch to the SEND-REC position.

**4.07** The unit is now ready for use.

**CAUTION:** When using the **Model TTS 4XMP** at frequencies below 200 cps, it is necessary to switch the SEND IMP switch to 600P. This disconnects the hold coil in the oscillator output circuit and increases the size of the DC blocking capacitor in the output transformer. Unless the 600P position is used, the output will fall off below 200 cps.

**4.08** If any of the frequencies on the basic test set are also needed for some tests, the SEND FREQ switch should be set to the desired frequency and the level calibration of the basic set should be rechecked.

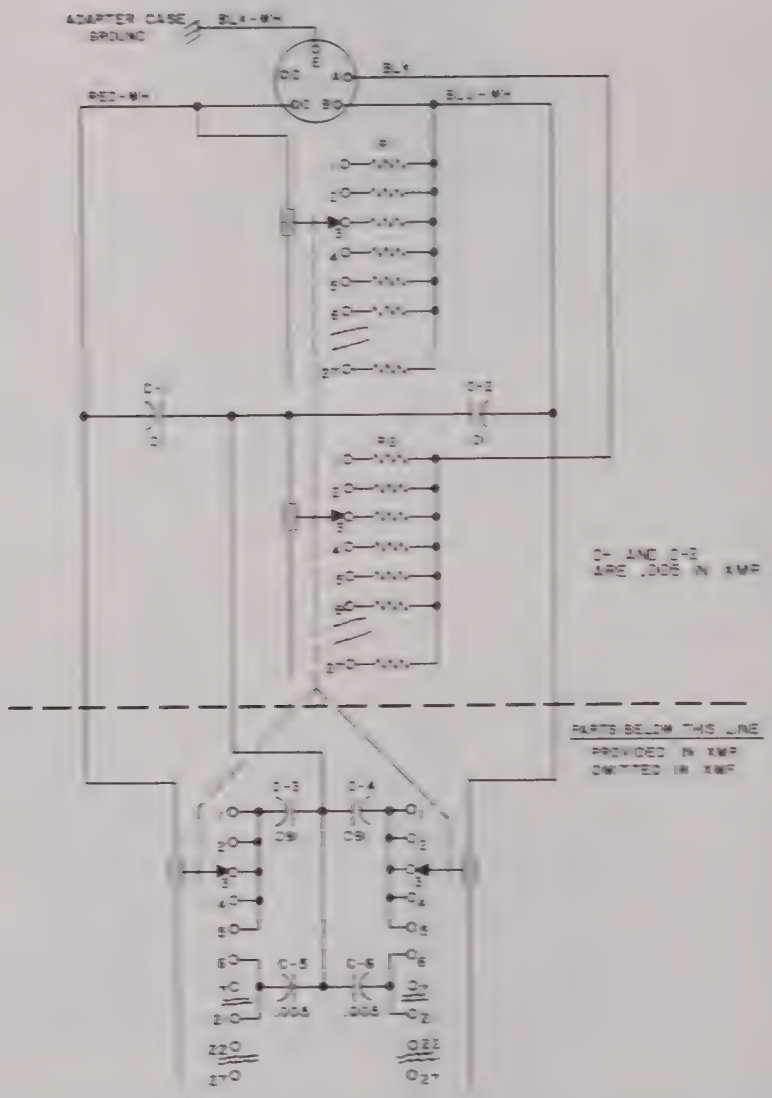
**CAUTION:** The Model TTS 4XMP and TTS 4XMF adapters have been adjusted for use with a specific TTS 4AN or 4ANH Test Set. To meet the level stability and frequency accuracy stated under Section 2.0, they should be used with the set for which they were calibrated.

**4.09** Instructions for the combination models mentioned in paragraph 1.02 are covered by the instructions for each of the units comprising a given combination.

**4.10** The hinged lid of the storage compartment may be opened or locked by turning the knob marked with an arrow.

## 5.0 MAINTENANCE

**5.01** The Models TTS 4XMF and TTS 4XMP do not require any routine maintenance.


ADAPTER CASE GROUND
BLK-W-
RED-W-
BLK
BLK-W-
C-
C-2
.005
C-3
C-4
C-5
C-6
C91
C91
.005
.005
C- AND C-2 ARE .005 IN XMP
PARTS BELOW THIS LINE
PROVIDED IN XMP
OMITTED IN XMP

Appendix 6

Page 1

# MODEL TTS 4XDLA LOOP AROUND ADAPTER

## OPERATING INSTRUCTIONS

### 1.0 GENERAL

**1.01** The Model TTS 4XDLA, which is available as an accessory cover for the Models TTS 4AN and 4ANH Transmission Test Sets, provides means to facilitate making loop around measurements on circuits to offices equipped with the Model TTS 50 or equivalent Loop Around Test System. These loop around tests require calling two numbers assigned respectively to a milliwatt generator and a test termination; when both connections are held simultaneously, a loop around circuit is established.

### 2.0 DESCRIPTION

**2.01** The following functions are provided:

1. A FUNCTION key switch permits dialing out on either of two lines that can be connected to the set.
2. When dialing is completed, a termination of 600 or 900 ohms is applied to each circuit to serve as a terminating impedance and a hold circuit.
3. When the DIRECTION key switch is placed in either of the SEND and REC positions, a loop around measurement may be made in either direction. During measurements the TTS 4AN will provide the required termination and hold circuit.
4. A CALL RELEASE pushbutton switch permits releasing the circuit after tests have been completed.

**2.02** The TTS 4XDLA is housed in a cover measuring 8" x 11" x 5 1/2" and weighs approximately 5 1/2 pounds.

### 3.0 OPERATION

**3.01** The two lines to be tested are connected to the LINE A and LINE B jacks.

**3.02** A connecting cord is inserted between the LINE jack on the TTS 4AN and the LINE REC jack on the TTS 4XDLA.

**3.03** A connecting cord is inserted between the SEND jack on the TTS 4AN and the SEND jack on the TTS 4XDLA.

**3.04** Place the DIRECTION switch in the TERM A-TERM B position and place the TERM switch in the proper position to match the impedance of the two lines under test.

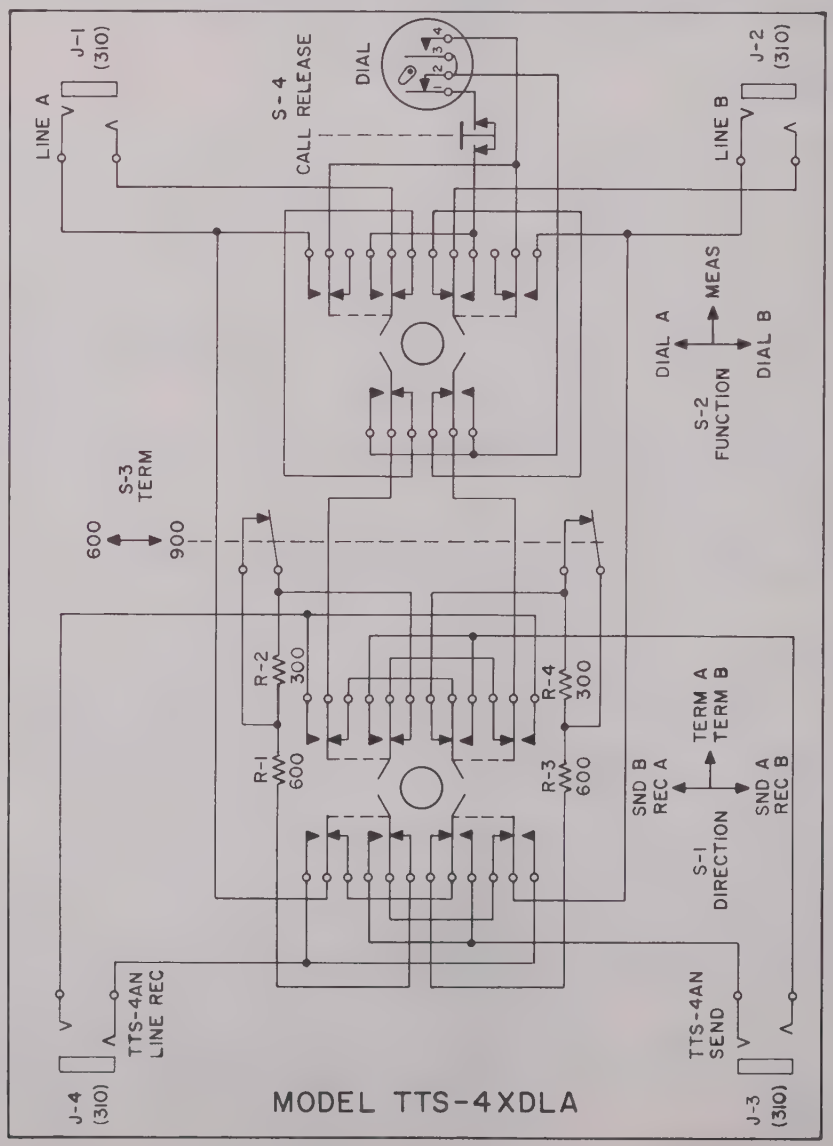
**3.05** Place the FUNCTION switch in the DIAL A position and dial the necessary number to reach one input of the remote loop around equipment.

**3.06** Place the FUNCTION switch in the DIAL B position and dial the necessary number to reach the second input of the remote loop around equipment.

**3.07** Place the FUNCTION switch in the MEAS position. The loop around circuit is now prepared for transmission measurements, the direction of which is determined by the DIRECTION switch.

## 4.0 MAINTENANCE

**4.01** The Model TTS 4XDLA does not require any routine maintenance.



# MODEL TTS 4XDVLA VARIABLE FREQUENCY AND LOOP AROUND ADAPTER COVER

## OPERATING INSTRUCTIONS

### 1.0 GENERAL

**1.01** The Model TTS 4XDVLA is an accessory cover for the Models TTS 4AN and 4ANH Transmission Test Sets. It contains an external frequency determining network for the TTS 4AN and 4ANH as well as the necessary functional switching, jacks, and a telephone dial to facilitate making loop around measurements. The TTS 4XDVLA therefore combines the features of the TTS 4XV variable frequency accessory cover and the TTS 4XDLA loop around accessory cover.

### 2.0 DESCRIPTION

**2.01** A detailed description of the circuits, their applications and operations are contained in Appendices 4 and 6 of this manual and therefore will not be duplicated here.

**2.02** The TTS 4XDVLA is housed in a cover measuring 11" x 8" x 5 3/4" and weighs approximately 8 pounds.

## MODELS TTS 4AN/4ANH

## INTERNAL BATTERY AND EXTERNAL 48-VOLT OPERATION

The Models TTS 4AN and 4ANH Transmission Test Sets were originally designed to operate on internal batteries. Eveready Type 226 or equivalent dry batteries in which the electrodes are zinc and carbon have been recommended. The service obtained from this type of battery will depend on several factors, including current drain, discharge temperature, discharge time cycle, end point voltage, and storage prior to use.

Temperature plays an important part in dry cell service. Most dry batteries are designed to operate near 70°F. Prolonged exposure to temperatures much above 130°F may cause the battery to fail suddenly.

A reduction in ambient temperature reduces the energy output. If ordinary dry batteries have been stored at room temperature of about 70°F and are then removed to a cold location of 0°F or below, it will require several hours for battery temperature to drop significantly. During this period the battery will continue to operate, though at slightly lower voltage caused by the lower temperature.

After prolonged exposure to 0°F or slightly below, ordinary batteries will give very little service except on relatively slight drains. After prolonged exposure to about -10°F they will become useless even on light drains.

Service life at low temperatures is reduced because of retarded chemical action within the cell. Exposure to low temperatures will not damage dry cells. In fact, low temperature storage is extremely beneficial to shelf life. When removed from low temperature storage the cells may be warmed to return them to their original condition.

High temperature storage is harmful to dry cells and serves to reduce their shelf life. For this reason dry batteries should be stored in cool locations.

The service life of dry batteries varies with use. Continuous operation shortens battery life substantially as compared to intermittent operation. When batteries are discharging, there is a steady drop in output voltage and over prolonged periods of continuous use this drop is sufficient to cause a change in calibration.

Unless it is necessary to use the instrument continuously, it is recommended that it be turned off when there is a waiting period between measurements to preserve battery life.

If the applications require continuous operation of the instrument in an office where 48 volts DC is available, the TTS 4AN and 4ANH are supplied for operation on either internal battery or external 48 volts. A jack which will accommodate a 310 type plug is

mounted on the front panel for the 48-volt connection, and the power switch can be moved to either internal battery or 48-volt operation.

When purchasing replacement batteries, care should be exercised in obtaining them from a reliable source. Batteries that have been on the shelf a long time can run down quickly. Battery manufacturers recommend storage in a cool place.

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